ECONOMIC ANALYSIS OF THE FINAL RULE TO MODIFY REPORTING OF PERSISTENT BIOACCUMULATIVE TOXIC CHEMICALS UNDER EPCRA SECTION 313

Economic and Policy Analysis Branch
Economics, Exposure and Technology Division
Office of Pollution Prevention and Toxics
U.S. Environmental Protection Agency

October 1999

NOTE

This document is not intended to serve as official guidance and should not be relied upon to determine applicable regulatory requirements. This document was prepared to provide economic information for the rulemaking process, and to meet various administrative and legislative requirements. Due to the nature of the information available to EPA, the document contains various assumptions that may not reflect the reporting determinations that an individual facility would make, were it to apply the reporting requirements to its specific processes and circumstances.

Persons seeking information on regulatory requirements as they apply to specific facilities should consult 40 CFR Part 372; the preambles for regulatory actions implemented under section 313 of the Emergency Planning and Community Right-to-Know and section 6607 of the Pollution Prevention Act; EPA's "Toxic Chemical Release Inventory Reporting Forms and Instructions"; guidance documents that EPA has published for specific chemicals and industries; and the Emergency Planning and Community Right-to-Know Information Hotline.

TABLE OF CONTENTS

Summary S-1
S.1 Introduction S-1
S.2 Need for the Rule S-1
S.3 Changes to TRI Reporting Requirements S-2
S.3.1 Lower Reporting Thresholds S-2
S.3.2 Addition of Chemicals S-4
S.3.3 Other Changes to TRI Reporting Requirements S-4
De Minimis Exception S-4
Alternate Threshold and Form A S-4
Range Reporting S-4
Half-pound Rule and Whole Number Reporting S-5
Reporting Limitation for Vanadium in Alloys S-5
Activity Qualifier for Dioxin Listing S-5
S.4 Estimated Reporting Activity S-5
S.5 Costs of the Final Rule S-7
S.5.1 Private Industry Costs S-7
S.5.2 Costs to Publicly Owned Facilities S-7
S.5.3 EPA Costs S-8
S.5.4 Summary of Costs S-8
S.6 Impacts of the Final Rule S-8
S.6.1 Impacts on Small Entities S-8
S.6.2 Impacts on Certain Demographic Groups S-9
S.7 Benefits of the Final Rule S-9

Chapter 1: Background, Statement of Need, Statutory Authority and Overview of Analysis 1-1
1.1 Statutory and Regulatory History 1-2
1.1.1 Passage of EPCRA 1-2
1.1.2 Overview of TRI 1-2
1.1.3 Pollution Prevention Act 1-3
1.1.4 Changes to the List of Chemicals 1-3
1.1.5 Alternate Threshold 1-4
1.1.6 Executive Order 12856 1-5
1.1.7 Changes to the List of Industries 1-5
1.2 Summary of TRI Reporting Requirements 1-5
1.2.1 Definition of a Facility 1-6
1.2.2 Full-time Employee Determination 1-6
1.2.3 Threshold Determinations 1-6
1.2.4 Exemptions 1-7

1.2.5 Use of Readily Available Data for Reporting 1-8
1.2.6 Other 1-8
1.3 Public Access to and Uses of the TRI Data 1-10
1.4 Statement of Need 1-10
1.4.1 The Theory of Market Failure 1-11
1.4.2 The Effect of TRI Information on Market Failure 1-18
1.5 Statutory Authority 1-20
1.6 Purpose and Scope of this Report 1-20
1.7 Organization of this Report 1-21
Literature Cited 1-22

Chapter 2: Description of Regulatory Options 2-1
2.1 Background 2-1
2.2 Revised Reporting Thresholds 2-2
2.3 Other Changes 2-4
2.3.1 Addition of Chemicals 2-4
2.3.2 Elimination of *De Minimis* Exemption for PBT Chemicals 2-5
2.3.3 Alternate Threshold and Form A 2-6
2.3.4 Range Reporting 2-7
2.3.5 Half-pound Rule and Whole Number Reporting 2-8
2.3.6 Reporting Limitation for Vanadium in Alloys 2-8
2.3.7 Activity Qualifier for Dioxin Listing 2-9

Chapter 3: Estimates of the Number of Additional Reports and Affected Facilities 3-1
3.1 Estimated Number of Additional Reports 3-1
3.2 Estimated Number of Affected Facilities 3-3
Literature Cited 3-9

Chapter 4: Cost Estimates 4-1
4.1 Industry Cost Estimates 4-1
4.1.1 Methodology 4-1
4.1.2 Unit Cost Estimates 4-3
4.1.3 Total Industry Costs 4-14
4.1.4 Costs for Publicly-owned Facilities 4-23
4.1.5 Transfer Payments and Non-monetized Costs 4-24
4.2 EPA Costs 4-24
4.3 Total Costs 4-25
Literature Cited 4-26

Chapter 5: Estimated Impacts of the Rule 5-1
5.1 Impacts on Small Entities 5-1
5.1.1 Definitions of Small Entities 5-1
5.1.2 Methodology Overview 5-3
5.1.3 Generation of Company Revenue Data 5-4
5.1.4 Estimating Small Company Impacts 5-6
5.1.5 Summary of Small Entity Impacts 5-24
5.2 Impacts on Certain Demographic Groups 5-24
Literature Cited 5-25

Chapter 6: Benefits 6-1
6.1 Introduction 6-1
6.2 Theoretical Basis for Estimating Benefits 6-4
6.2.1 Theoretical Framework for Assessment of PBT Information Benefits . 6-4
6.2.2 Potential Benefits of TRI Information by User Group 6-11
6.3 Evidence of TRI Information Use 6-14
6.3.1 General Assessments 6-14
6.3.2 Detailed Assessments by User Type 6-18
6.4 Case Study 6-36
6.4.1 the Potential Benefits of More Accurate, Complete, and Consistent PBT Chemical Reporting in the Great Lakes Basin 6-37
6.5 Summary 6-48
Literature Cited 6-50

Appendix A: Combustion A-1
A.1 Background A-1
A.2 Estimation of Reporting for Manufacturing Facilities A-1
A.2.1 Typical Chemical Concentrations in Various Fuels A-2
A.2.2 Fuel Usage Required to Exceed Reporting Thresholds A-3
A.2.3 Percentage of Facilities Meeting the Minimum Fuel Requirements A-4
A.2.4 Total Number of Manufacturing Facilities Subject to TRI Using Various Fuels A-7
A.3 Estimation of Reporting from Electric Utilities A-10
A.4 Summary A-10
Literature Cited A-14

Appendix B: Dioxin and Dioxin-like Compounds B-1
B.1 Introduction B-1
B.2 Toxicity Equivalence Factors B-1
B.3 Formation B-2

B.4 Production B-2
B.4.1 Combustion Sources B-4
B.4.2 Metallurgical Processes B-5
B.4.3 Chemical Manufacturing and Industrial Processes B-6
B.4.4 Reservoir Sources B-7
B.4.5 Source Categories with Order of Magnitude Estimates B-7
B.5 Present TRI Status B-7
B.6 Methodology for Evaluating the Number of Facilities Affected by TRI Reporting for Dioxins and Furans B-8
B.6.1 Determining Facility-level CDD/CDF Releases Within a Source Category B-9
B.6.2 Non-detected Levels of Dioxins and Furans from Actual Testing B-13
B.7 Summary of Results — Expected Reporting B-14
Literature Cited B-16
Personal Communications B-18

Appendix C: Hexachlorobenzene C-1
C.1 Chemical Profile C-1
C.1.1 Production C-1
C.1.2 Releases C-3
C.2 Current Toxics Release Inventory (TRI) Status C-3
C.3 Estimated Number of Additional Reports C-4
C.3.1 Analytical Methods C-4
C.4 Conclusions C-16
Literature Cited C-17
Personal Communications C-19

Appendix D: Mercury and Mercury Compounds D-1
D.1 Chemical Profile D-1
D. 1. 1 Production D-1
D. 1. 2 Uses D-1
D. 1. 3 Releases D-2
D.2 Current Toxics Release Inventory (TRI) Status D-4
D.3 Estimated Number of Additional Reports D-7
D. 3. 1 Analytical Methods D-7
D.4 Conclusions D-37
Literature Cited D-38
Personal Communications D-41

Appendix E: Octachlorostyrene E-1
E.1 Chemical Profile E-1
E.2 Current Toxics Release Inventory (TRI) Status E-2
E.3 Estimated Number of Additional Reports to TRI E-2
E.3.1 Analytical Methods E-2
E.4 Conclusions E-10
Literature Cited E-11
Personal Communications E-13

Appendix F: Pentachlorobenzene F-1
F.1 Chemical Profile F-1
F.2 Current Toxic Release Inventory (TRI) Status F-1
F.3 Estimated Number of Additional Reports F-2
F.3.1 Analytical Methods F-2
F.3.2 Summary F-10
F.4 Conclusions F-12
Literature Cited F-13
Personal Communications F-15

Appendix G Pesticides: Aldrin, Chlordane, Dicofol, Heptachlor, Isodrin, Methoxychlor, Pendimethalin, Toxaphene, Trifluralin G-1
G.1 Aldrin G-1
G.1.1 Production G-1
G.1.2 Uses and Releases G-2
G.2 Chlordane G-2
G.2.1 Production G-2
G.2.2 Uses and Releases G-3
G.3 Dicofol G-3
G.3.1 Production G-3
G.3.2 Uses and Releases G-4
G.4 Heptachlor G-4
G.4.1 Production G-4
G.4.2 Uses and Releases G-5
G.5 Isodrin G-5
G.5.1 Production G-5
G.5.2 Uses and Releases G-6
G.6 Methoxychlor G-6
G.6.1 Production G-6
G.6.2 Uses and Releases G-6
G.7 Pendimethalin G-7
G.7.1 Production G-7
G.7.2 Uses and Releases G-7

G.8 Toxaphene G-8
G.8.1 Production G-8
G.8.2 Uses and Releases G-9
G.9 Trifluralin G-9
G.9.1 Production G-9
G.9.2 Uses and Releases G-10
G.10 Estimated Number of TRI Reports on PBT Pesticides at Lower Threshold Levels G-11
G.10.1 Manufacture and Process G-11
G.10.2 Otherwise Use G-13
G.10.3 Summary G-14
Literature Cited G-16

Appendix H: Polycyclic Aromatic Compounds, and Benzo(g,h,i)perylene H-1
H.1 Chemical Profile H-1
H.1.1 Production H-2
H.1.2 Uses H-4
H.2 Current Toxic Release Inventory (TRI) Status H-4
H.3 Estimated Number of Additional Reports H-5
H.3.1 Analytical Methods H-5
H.3.4 Conclusions H-15
Literature Cited H-16

Appendix I: Polychlorinated Biphenyls I-1
I.1 Chemical Profile I-1
I.1.1 Production I-1
I.1.2 Uses I-1
I.1.3 Releases I-4
I.2 Current Toxic Release Inventory (TRI) Status I-6
I.3 Estimated Number of Additional Reports I-6
I.3.1 Analytical Methods I-6
I.4 Conclusions I-17
Literature Cited I-18
Personal Communications I-20

Appendix J: Tetrabromobisphenol A J-1
J.1 Chemical Profile J-1
J.1.1 Production J-1
J.1.2 Uses J-1
J.2 Current Toxic Release Inventory (TRI) Status J-2

J.3 Estimated Number of Additional Reports J-2
J.3.1 Analytical Methods J-2
J.4 Conclusions J-6
Literature Cited J-7
Personal Communications J-8

Appendix K: Vanadium and Vanadium Compounds K-1
K.1 Chemical Profile K-1
K.1.1 Production K-1
K.1.2. Uses K-1
K.2 Current Toxic Release Inventory (TRI) Status K-3
K.3 Estimated Number of Additional Reports K-3
K.3.1 Analytical Methods K-3
K.4 Conclusions K-14
Literature Cited K-15
Personal Communication K-18

Appendix L: Associated Requirements L-1
L.1 Introduction L-1
L.2 State Associated Requirements L-1
L.2.1 State Pollution Prevention Planning Requirements L-1
L.2.2 Pollution Prevention Fees L-2
Arizona L-2
Colorado L-2
Florida L-2
Iowa L-3
Kansas L-3
Maine L-3
Massachusetts L-3
Minnesota L-4
Mississippi L-4
Nevada L-5
New Jersey L-5
Ohio L-6
Oregon L-6
Pennsylvania L-6
South Dakota L-6
Texas L-7
L.3 NPDES Storm Water Permits L-7
Literature Cited L-10

LIST OF TABLES AND FIGURES

Table S-1: Regulatory Options For Lower Reporting Thresholds S-3
Table S-2: Estimated Number of Additional Reports S-6
Table S-3: Summary of Reporting And Associated Cost to Industry S-7
Table S-4: Summary of Total Costs of Final Rule (Option 2) S-8
Figure 1-1: Market Efficiency 1-12
Figure 1-2: Sources of Market Failure 1-13
Figure 1-3: Information Provision and Efficiency 1-14
Figure 1-4: The Inefficiencies of Standards 1-15
Table 2-1: PBT Threshold Regulatory Options 2-4
Table 3-1: Reporting of PBT Chemicals to TRI in 1996 3-2
Table 3-2: Numbers of Reports Expected For Each PBT Chemical 3-3
Table 3-3: Numbers of Unique Facilities And Reports by Industry Group 3-8
Table 4-1: Estimated Number of Unique Facilities And Chemical Reports Under The Final Rule 4-4
Table 4-2: Unit Time And Cost Estimates For Activities Performed by Industry 4-5
Table 4-3: Loaded Hourly Wage Rates by Labor Category 4-6
Table 4-4: Number of Facilities Conducting Compliance Determinations Final Rule — All Options 4-8
Table 4-5: Adjusted Unit Costs For Compliance Determination by Option 4-10
Table 4-6: Number of Unique Facilities And First Time Filers 4-11
Table 4-7: Number of Facilities Expected to Provide Supplier Notification Under The Final Rule 4-12
Table 4-8a: Distribution of Estimated Costs by Compliance Activity Option 1 - First Year 4-15
Table 4-8b: Distribution of Estimated Costs by Compliance Activity Option 1 - Subsequent Year 4-16
Table 4-9a: Distribution of Estimated Costs by Compliance Activity Option 2 - First Year 4-17
Table 4-9b: Distribution of Estimated Costs by Compliance Activity Option 2 - Subsequent Year 4-18
Table 4-10a: Distribution of Estimated Costs by Compliance Activity Option 3 - First Year 4-19
Table 4-10b: Distribution of Estimated Costs by Compliance Activity Option 3 - Subsequent Year 4-20
Table 4-11a: Distribution of Estimated Costs by Compliance Activity Option 4 - First Year 4-21
Table 4-11b: Distribution of Estimated Costs by Compliance Activity Option 4 - Subsequent Year 4-22

Table 4-12: Reporting Estimates For Publicly-owned Facilities Final Rule - All Options 4-23
Table 4-13: Estimated Costs For Publicly-owned Facilities All Options 4-23
Table 4-14: Summary of Incremental EPA Costs Selected Option 4-25
Table 4-15: Summary of Total Costs Final Rule 4-25
Table 5-1: Range of Reports Per Facility and Average Number of Facilities Per Company .. 5-8
Table 5-2: Company-level Cost Impact Percentages Selected Option - First Year Range of Impacts 5-9
Table 5-3 : Estimated Number of Affected Small Entities Selected Option 5-11
Table 5-4: Summary of Impacts on Small Entities First Year Selected Option 5-18
Table 5-5: Estimated Impacts on Coal- And Oil-fired Electric Services SIC Code 4911 Selected Option 5-22
Table 5-6: Estimated Impacts For Municipally-owned Electric Utilities SIC Code 4911 Selected Option 5-23
Table 6-1: Potential Benefits and Costs Associated with the Final Rule and with Follow-on Activities 6-2
Figure 6-1: Sources of Market Failure 6-5
Figure 6-2: Information Provision and Efficiency 6-6
Table 6-2: TRI User Types as a Percentage of Users Based on the Three Primary Access Routes 6-16
Table 6-3: Summary Statistics of Bibliography Database 6-17
Table 6-4: Uses of TRI Data 6-18
Table 6-5: State Uses of TRI Data 6-32
Table 6-6: Changes in TRI Data Use by States 6-34
Table 6-7: Summary of Fish Consumption Advisories for the Great Lakes 6-38
Table 6-8: PBT Chemicals Regulated Under Final Rule That Were Addressed in Great Lakes Water Quality Guidance and Other Research and Regulatory Efforts Discussed in the Case Study 6-40
Table 6-9: Estimated Share of Total Loadings Attributable to Effluent Point Sources Used in the Great Lakes Water Quality Guidance Regulatory Impact Analysis 6-41
Table 6-10: Summary of the Types of Research and Toxic Pollution Control Efforts in the Great Lakes Basin That Could Benefit from the Final Rule 6-43
Table A-1: Estimated Quantity of Fuel Throughput Required to Exceed Lower Reporting Thresholds A-2
Table A-2: Conversion Factors Used to Calculate Fuel Throughputs A-3
Table A-3: Fuel Throughput of Manufacturing Facilities (15) A-6
Table A-4: Percentage of Manufacturing Facilities with Fuel Combustion Activities That Exceed the 1-, 10-, 100-, 1,000-pound Thresholds by Fuel Type and PBT Chemical A-8
Table A-5: Number of Manufacturing Facilities Using Various Fuel Types A-9
Table A-6: Number of Manufacturing Facilities Exceeding the Lower Reporting Thresholds A-9
Table A-7: Percentage of Facilities in SIC Code 4911 Exceeding The Lower Thresholds ... A-11

Table A-8: Total Number of Facilities in SIC 4911, 4931, And 4939 Exceeding The Lower Thresholds A-12
Table A-9: Summary of Combustion-related TRI Reports at Lower Thresholds A-13
Table B-1: National 1990 Alkylated Lead Emission Estimates B-2
Table B-2: Summary of TRI Reporting For Lead Compounds, 1996 . . . . . B-4
Table B-3: Summary of Estimates of Additional TRI Reporting For Tetraethyl Lead (TEL) And Tetramethyl Lead (TML) B-8
Table B-1: Toxicity Equivalence Factors (TEF) For CDDs And CDFs B-2
Table B-2: 1995 Dioxin And Furan Emissions Inventory for the United States B-3
Table B-3: Order of Magnitude Estimates of CDD/CDF Releases From Sources Not Quantified in The National Inventory (Reference Year 1995) B-8
Table B-4: Dioxins And Furans Summary Table (ND = ½ DL) B-13
Table B-5: Estimates of Additional TRI Reporting For Dioxin and Dioxin-like Compounds B-15
Table C-1: Summary of TRI Reporting For Hexachlorobenzene, 1996 . . . . . C-3
Table C-2: Chemicals Suspected to Contain Hexachlorobenzene C-5
Table C-3: Estimated Number of Aluminum Foundries Using Hexachloroethane (HCE) Degassing Operations C-8
Table C-4: Estimated Aluminum Industry Hexachlorobenzene Manufacture C-9
Table C-5: Chemicals Reported Above 25,000 Pounds in Phone Survey of Solvent Recyclers From TRI Industry Expansion C-11
Table C-6: Summary of Estimates of Additional TRI Reporting For Hexachlorobenzene (HCB) C-14
Table D-1: Best Point Estimates of 1994-1995 National Emission Rates by Category D-2
Table D-2a: Summary of TRI Reporting For Mercury, 1996 . . . . . D-5
Table D-2b: Summary of TRI Reporting For Mercury Compounds, 1996 . . . . . D-5
Table D-3: Mercury And Mercury Compounds Reporting For Expansion Industries D-6
Table D-4: Potential TRI Reporting at Lower Threshold For Metal Mining D-10
Table D-5: Mercury Usage at Carbon Black Facilities D-15
Table D-6: Portland Cement Facilities at Each Mercury Usage Range D-17
Table D-7: Estimated Mercury Usage at Coke Production Facilities Based on Capacity and Industry Coal Consumption D-20
Table D-8: Mercury Concentrations by Battery Type D-24
Table D-9: SIC Code 4911, 4931, And 4939 Facilities Expected to Submit TRI Reports For Mercury at Lower Reporting Thresholds D-26
Table D-10: Annual Throughput Estimates And Total Number of Facilities by SIC Code 5171 Model Facilities D-29
Table D-11: Estimated Mercury Usage For SIC Code 5171 Model Facilities D-30
Table D-12: Summary of Estimates of Additional Reporting For Mercury And Mercury Compounds D-33

Table E-1: Estimated OCS Manufacture Based on Hexachlorobenzene Manufacture/Releases E-4
Table E-2: Estimated Number of Facilities Potentially Producing OCS From Selected Manufacturing Sectors E-5
Table E-3: Estimated Number of Aluminum Foundries Using HCE Degassing Operations . . . E-6
Table E-4: Estimated Aluminum Industry OCS Manufacture E-7
Table E-5 : Estimates of Additional TRI Reporting For Octachlorostyrene (OCS) E-9
Table F-1: Summary of TRI Reporting For Quintozene, 1995 . . . . . F-1
Table F-2: Chemicals Suspected to Contain Pentachlorobenzene F-4
Table F-3: Chemicals Reported Above 25,000 Pounds in Phone Survey of Solvent Recyclers From TRI Industry Expansion F-7
Table F-4: Summary of Estimates of Additional TRI Reporting For Pentachlorobenzene (5CB) F-11
Table G-1: 1996 TRI Reporting For Chlordane G-3
Table G-2: 1996 TRI Reporting For Dicofol G-4
Table G-3: 1995 TRI Reporting For Heptachlor G-5
Table G-4: 1996 TRI Reporting For Methoxychlor G-7
Table G-5: 1996 TRI Reporting For Pendimethalin G-8
Table G-6: 1996 TRI Reporting For Trifluralin G-10
Table G-7: Expected Additional TRI Reporting on PBT Pesticides Manufacture & Process . G-13
Table G-8: Expected Additional TRI Reporting on PBT Pesticides: Otherwise Use G-14
Table G-9: Expected Additional TRI Reporting on PBT Pesticides G-15
Table H-1: Summary of 1990 Air Emissions Inventory For PACs (Tons/yr) H-3
Table H-2: Summary of TRI Reporting For PACs Category, 1996 . . . . . H-5
Table H-3: Annual Throughput Estimates And Total Number of Facilities For SIC Code 5171 Model Facilities H-10
Table H-4: Estimated Throughput Per Facility Based on Model Facilities H-11
Table H-5: Summary of Estimates of Additional TRI Reporting For Polycyclic Aromatic Compounds H-13
Table H-6: Summary of Estimates of Additional TRI Reporting For Benzo(g,h,i)perylene . . H-14
Table H-7: Summary of Estimates of Additional TRI Reporting For Polycyclic Aromatic Compounds (PACs) And Benzo(g,h,i)perylene H-15
Table I-1: Industrial Uses of PCBs (1929-1975) I-3
Table I-2: Amount of PCBs in Storage For Disposal in The United States I-4
Table I-3: Estimated 1990 U.S. PCB Emissions to Air I-5
Table I-4: U.S. PCB Contaminated Waste Disposal Amounts (Disposal in Landfills or Destructive Incineration) I-5
Table I-5: Summary of TRI Reporting For PCBs, 1996 . . . . . I-6
Table I-6: Estimated Number of Non-utility Facilities With PCB Electrical Equipment I-9
Table I-7: Annual Throughput Estimated And Total Number of Facilities For SIC Code 5171 Model Facilities I-13

Table I-8: Estimated PCB Processing For SIC Code 5171 Model Facilities I-14
Table I-9: Summary of Estimates of Additional TRI Reporting for Polychlorinated Biphenyls (PCBs) I-15
Table J-1: Summary of Estimates of Additional TRI Reporting for Tetrabromobisphenol A (TBBPA) J-5
Table K-1: 1996 U.S. Vanadium Consumption by End Use K-2
Table K-2: Summary of TRI Reporting for Vanadium (Fume or Dust), 1996 . . . . . K-3
Table K-3: Estimated Vanadium Throughput per Facility Based on Model Facilities K-10
Table K-4: Summary of Estimates of Additional TRI Reporting for Vanadium and Vanadium Compounds K-12

SUMMARY

S.1 INTRODUCTION

Under section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA), and section 6607 of the Pollution Prevention Act (PPA), certain facilities are required to file annual reports to the United States Environmental Protection Agency (EPA) and to states on their releases, transfers, and other waste management practices for certain toxic chemicals if they are manufactured, processed, or otherwise used above certain threshold amounts. This information is included in a publicly available database known as the Toxic Release Inventory (TRI).

The reporting thresholds under section 313(f)(1) of EPCRA are 25,000 pounds for chemicals that are manufactured or processed and 10,000 pounds for chemicals that are otherwise used. Section 313(f)(2) authorizes EPA to revise these reporting thresholds. Under the final rule, EPA will revise the reporting thresholds for TRI chemicals that persist and bioaccumulate in the environment, add certain toxic chemicals to the list of reportable substances, and modify other reporting requirements for persistent bioaccumulative toxic (PBT) chemicals.

S.2 NEED FOR THE RULE

For certain chemicals, such as those that persist in the environment and bioaccumulate, important information about releases and other waste management activities may not be available to the public because facilities manufacture, process or otherwise use the chemicals at levels below the current TRI reporting thresholds. Since PBT chemicals can remain in the environment for a significant amount of time and can accumulate in animal tissues, even relatively small releases of such chemicals from individual facilities may have significant adverse effects on human health and the environment. This situation results in a market failure. Markets fail to achieve socially efficient outcomes when differences exist between market values and social values. Two causes of market failure are externalities and information asymmetries.

In the case of negative externalities, the actions of one party impose costs on other parties that are “external” to any market transaction. For example, a facility may release toxic chemicals without accounting for the consequences to other parties, such as the surrounding community, and the prices of that facility’s goods or services will fail to reflect those costs.

The market may also fail to efficiently allocate resources in cases where consumers lack information. For example, when toxic release information is insufficient, individuals’ choices regarding where to live and work may not be the same as if they had more complete information. Since firms ordinarily have little or no incentive to provide information on their releases and other waste management activities involving toxic chemicals, the market fails to allocate society’s resources in the most efficient manner.

Federal regulations exist, in part, to address significant market failures. In cases where the market is unlikely to provide adequate information, public intervention can provide consumers and possibly producers with information that will allow them to make better decisions. The final rule addresses the market failures arising from private choices about PBT chemicals that have societal costs, and the market failures created by the limited information available to the public about the releases and other waste management of PBT chemicals.

S.3 CHANGES TO TRI REPORTING REQUIREMENTS

As part of the final rule, EPA is lowering reporting thresholds for certain TRI chemicals that persist and bioaccumulate. In addition, EPA is adding certain PBT chemicals not already listed on TRI to the list of reportable substances. EPA is also making other changes in TRI reporting on PBT chemicals to improve the quality of information on these chemicals. These actions are described below in more detail.

S.3.1 LOWER REPORTING THRESHOLDS

EPA used a tiered approach in considering lower reporting thresholds for toxic chemicals with varying potentials for bioaccumulation and persistence. EPA first identified a group of chemicals that are persistent and bioaccumulative. EPA then separated the PBT chemicals into two subsets based on persistence and bioaccumulation potential:

- ***Highly* Persistent Bioaccumulative Chemicals**: section 313 chemicals that persist in the environment with a half-life of 6 months or greater and that have bioaccumulation or bioconcentration factor values of 5,000 or greater;

- **Persistent Bioaccumulative Chemicals**: section 313 chemicals that persist in the environment with a half-life between 2 and 6 months and that have bioaccumulation or bioconcentration factor values between 1,000 and 5,000.

The thresholds for specific PBT chemicals or chemical categories under the four regulatory options that were considered are presented in Table S-1. Option 2 is the selected option as presented in the regulatory text. Under Option 2, the lower reporting thresholds will be 10 pounds for the highly persistent bioaccumulative chemicals, 100 pounds for the persistent bioaccumulative chemicals, and 0.1 gram for the category of dioxin and dioxin-like compounds. The reporting threshold for vanadium and vanadium compounds will remain at the current thresholds of 25,000 lbs manufactured or processed and 10,000 lbs otherwise used across all regulatory options.

TABLE S-1
REGULATORY OPTIONS FOR LOWER REPORTING THRESHOLDS

Chemical	Option 1	Option 2 (Selected Option)	Option 3	Option 4
Highly Persistent Bioaccumulative Toxic Chemicals				
Benzo(g,h,i)perylene	1 lb	10 lbs	100 lbs	1,000 lbs
Chlordane	1 lb	10 lbs	100 lbs	1,000 lbs
Heptachlor	1 lb	10 lbs	100 lbs	1,000 lbs
Hexachlorobenzene	1 lb	10 lbs	100 lbs	1,000 lbs
Isodrin	1 lb	10 lbs	100 lbs	1,000 lbs
Mercury; Mercury Compounds Category	1 lb	10 lbs	100 lbs	1,000 lbs
Octachlorostyrene	1 lb	10 lbs	100 lbs	1,000 lbs
Pentachlorobenzene	1 lb	10 lbs	100 lbs	1,000 lbs
Polychlorinated Biphenyls (PCBs)	1 lb	10 lbs	100 lbs	1,000 lbs
Toxaphene	1 lb	10 lbs	100 lbs	1,000 lbs
Vanadium; Vanadium Compounds Category	10,000/ 25,000 lbs*	10,000/ 25,000 lbs*	10,000/ 25,000 lbs*	10,000/ 25,000 lbs*
Persistent Bioaccumulative Toxic Chemicals				
Aldrin	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Methoxychlor	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Pendimethalin	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Polycyclic Aromatic Compounds Category	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Tetrabromobisphenol A	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Trifluralin	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Dioxin and Dioxin-Like Compounds Category				
Dioxin and Dioxin-Like Compounds Category	0.1 gram	0.1 gram	0.1 gram	1 gram

* Under this rule, vanadium will be reported on at the current thresholds of 10,000 lbs otherwise use and 25,000 lbs manufactured or processed.

S.3.2 ADDITION OF CHEMICALS

EPA is adding seven chemicals and two categories of chemicals that persist and bioaccumulate in the environment to reporting under EPCRA section 313. These chemicals are benzo(g,h,i)perylene, benzo(j,k)fluorene (fluoranthene), 3-methylcholanthrene, octachlorostyrene, pentachlorobenzene, tetrabromobisphenol A, vanadium[1], vanadium compounds, and dioxin and dioxin-like compounds.[2] While these chemicals were identified based on their persistence and bioaccumulation characteristics, their addition to TRI is based solely on the determination that they meet the hazard assessment criteria in EPCRA section 313(d)(2)(B) or (C).

S.3.3 OTHER CHANGES TO TRI REPORTING REQUIREMENTS

De Minimis Exemption

For the PBT chemicals subject to lower reporting thresholds, EPA is eliminating the *de minimis* exemption. The current reporting requirements under section 313 allow facilities to disregard certain low concentrations of chemicals in mixtures or other trade name products in making threshold determinations for section 313 reporting. This *de minimis* exemption applies to mixtures and trade name products that are imported, manufactured as an impurity, processed, or otherwise used.

Alternate Threshold and Form A

EPA is requiring facilities to file a Form R report when they meet reporting criteria for PBT chemicals with lower reporting thresholds. Current reporting rules allow facilities to file a Form A instead of a Form R if they have less than 500 pounds of production-related waste of a listed toxic chemical and do not manufacture, process, or otherwise use more than one million pounds of that listed toxic chemical. The Form A is a certification statement; the release, transfer, and waste management information reported on the Form A is more limited than that provided by the Form R.

Range Reporting

EPA is requiring facilities to report numerical values for releases and off-site transfers for waste management of PBT chemicals. EPA currently allows facilities to use range codes in reporting less than 1,000 pounds of releases and off-site transfers for further waste management.

---

[1] Vanadium is currently listed on TRI with the qualifier: (fume or dust). EPA is removing the fume or dust qualifier for vanadium.

[2] Dioxin and dioxin-like compounds are listed with the qualifier: (manufacturing and the processing or otherwise use of chemicals and chemical mixtures that contain these compounds as impurities created as a result of their manufacturing processes).

Half-pound Rule and Whole Number Reporting

For PBT chemicals, EPA is requiring that all releases or other waste management quantities of greater than a tenth of a pound be reported, provided that the appropriate activity threshold has been exceeded and provided that the accuracy and underlying data support this level of precision. EPA is also requiring that for release and other waste management quantities less than ten pounds, fractional quantities (*e.g.*, 6.2 pounds) rather than whole numbers are to be reported. For the category of dioxin and dioxin-like compounds, EPA is requiring that facilities report all releases and other waste management quantities greater than 100 µg. EPA currently requires that facilities report numerical quantities as whole numbers. EPA also currently allows facilities to round releases of 0.5 pounds or less to zero.

For PBT chemicals, if the facility's release or other waste management estimates support reporting an amount that is more precise than whole numbers and two significant digits, then the facility should report that more precise amount. If the data and/or estimation techniques do not support this degree of accuracy, then the facility's estimates are not required to be reported to a greater degree of accuracy than is available.

Reporting Limitation for Vanadium in Alloys

Vanadium can be found in various types of alloys used at facilities which are subject to reporting under section 313. At this time EPA has not made a determination as to whether vanadium contained in alloys meets the EPCRA Section 313 criteria. Therefore, EPA is not requiring facilities to report on vanadium when contained in alloys. Under this limitation, once incorporated into an alloy, vanadium would not be reportable. Cutting, grinding, shaving, and other activities involving an alloy would not negate the reporting limitations for alloys containing vanadium.

Activity Qualifier for Dioxin Listing

EPA is changing the activity qualifier to the dioxin and dioxin-like compound category to focus reporting on facilities that actually add to the environmental loading of dioxin. With this qualifier, manufacturing, processing, or otherwise using chemicals and chemical mixtures that contain these compounds as impurities created as a result of their manufacturing processes would be subject to TRI reporting.

S.4 ESTIMATED REPORTING ACTIVITY

The number of additional TRI reports for each PBT chemical is summarized in Table S-2. Under Option 2, the selected option for the final rule, approximately 20,000 additional TRI reports on PBT chemicals are expected. Approximately 60 percent of these reports are triggered by the consumption of fuel (primarily coal and residual fuel oil) at manufacturing facilities and electric utilities. These fuels contain PBT chemicals, and facilities that use sufficient amounts of fuel may exceed the lower reporting threshold for PBT chemicals.

TABLE S-2
ESTIMATED NUMBER OF ADDITIONAL REPORTS

Chemical	Number of Reports			
	Option 1	Option 2 (Selected)	Option 3	Option 4
Benzo(g,h,i)perylene	4,487	909	21	0
Dioxins and Furans	1,475	1,475	1,475	826
Hexachlorobenzene	3,772	778	73	3
Mercury and Mercury Compounds	11,357	5,346	2,482	1,472
Octachlorostyrene	303	230	67	65
Pesticides	280	264	199	186
Pentachlorobenzene	3,314	707	36	11
Polychlorinated Biphenyl (PCBs)	3,634	2,310	1,301	187
Polycyclic Aromatic Compounds Category	13,337	7,166	3,217	3,217
Tetrabromobisphenol A	150	150	150	150
Vanadium and Vanadium Compounds	655	655	655	655
TOTAL	42,764	19,990	9,676	6,772

S.5 COSTS OF THE FINAL RULE

The final rule will result in the expenditure of resources that, in the absence of the regulation, could be used for other purposes. The cost of the final rule is the value of these resources in their best alternative use. Most of the costs of the final rule result from requirements on industry.

S.5.1 PRIVATE INDUSTRY COSTS

To estimate the industry costs of compliance, the unit cost for each task that a subject facility may be required to perform as a result of the final rule is multiplied by the relevant number of facilities or reports associated with that task. Table S-3 displays the industry costs for each regulatory option based on the estimated number of facilities affected and the estimated number of additional reports.

Under the option presented in the regulation text (Option 2), approximately 11,300 facilities will submit approximately 20,000 Form R reports annually. As shown, aggregate industry costs in the first year for this alternative are estimated to be $145 million; in subsequent years they are estimated to be $80 million per year. Industry costs are lower after the first year because facilities will be familiar with the reporting requirements, and many will be able to update or modify information from the previous year's report.

TABLE S-3
SUMMARY OF REPORTING AND ASSOCIATED COST TO INDUSTRY

Regulatory Options	Annual Number of Reports	Annual Number of Reporting Facilities	Estimated Industry Costs ($ million per year)	
			First Year	Subsequent Years
Option 1	42,764	24,206	$314	$171
Option 2 (Selected Option)	19,990	11,257	$145	$80
Option 3	9,676	5,354	$70	$39
Option 4	6,772	4,200	$49	$27

S.5.2 COSTS TO PUBLICLY OWNED FACILITIES

There are an estimated 44 publicly-owned coal- and oil-fired electric utility plants that will be affected by the final rule. Under Option 2, these facilities are estimated to submit a total of 125 reports at a cost of approximately $644,000 in the first year and $447,000 in subsequent years. These costs are reflected in the estimated industry costs shown in Table S-3.

S.5.3 EPA COSTS

EPA will incur costs as a result of the final rule. These costs include costs for data processing, outreach and training, information dissemination, policy and petitions, and compliance and enforcement. Under Option 2, EPA is expected to expend $2.0 million in the first year, and $1.6 million in subsequent years as a result of the final rule.

S.5.4 SUMMARY OF COSTS

The estimated total cost of the final rule is $147 million in the first year and $82 million in subsequent years. Table S-4 summarizes the total costs to industry and EPA of the final rule.

TABLE S-4
SUMMARY OF TOTAL COSTS OF FINAL RULE (OPTION 2)

DESCRIPTION	First Year ($ million)	Subsequent Years ($ million)
Industry Costs	$145	$80
EPA Costs	$2.0	$1.6
TOTAL COSTS	$147	$82

S.6 IMPACTS OF THE FINAL RULE

S.6.1 IMPACTS ON SMALL ENTITIES

The final rule may affect both small businesses and small governments. For analytical purposes, EPA defined a "small" business using the small business size standards established by the Small Business Administration (SBA). The SBA small business size standards are expansive, classifying most businesses as "small." EPA defined "small" governments using the RFA definition of jurisdictions with a population of less than 50,000. No small organizations are expected to be affected by the final rule. Only those small entities that are expected to submit at least one report are considered to be affected for the purpose of the small entity analysis. The number of affected entities will be smaller than the number of affected facilities, because some entities operate more than one facility.

Small Businesses

This analysis uses annual compliance costs as a percentage of annual company sales to assess the potential impacts of the rule on small businesses. This is a good measure of a firm's ability to afford the costs attributable to a regulatory requirement, because comparing compliance costs to revenues provides a reasonable indication of the magnitude of the regulatory burden

relative to a commonly available and stable measure of a company's business volume. Where regulatory costs represent a small fraction of a typical firm's revenue, the financial impacts of the regulation are likely to be minimal.

For the first reporting year, approximately 17 small businesses may bear annual compliance costs between 1 percent and 3 percent of revenues, and no small businesses will bear annual costs greater than 3 percent of annual revenues. In subsequent years, approximately 5 small businesses are predicted to face annual compliance costs between 1 percent and 3 percent of annual revenues, and no small businesses will bear annual costs greater than 3 percent of annual revenues. Impact percentages based on annual costs after the first year are the best measure to judge the impacts on small entities because these continuing costs are more representative of the costs firms face to comply with the final rule.

Small Governments

It is estimated that 44 publicly owned electric utility facilities, operated by a total of 34 municipalities, may be affected. Of these, an estimated 15 are operated by small governments (i.e., those with populations under 50,000). To assess the potential impacts on small governments, EPA used annual compliance costs as a percentage of the utility's annual revenues to measure potential impacts. Similar to the methodology for small businesses, this measure was used because it provides a reasonable indication of the magnitude of the regulatory burden relative to a government's ability to pay for the costs, and is based on readily available data. None of the 15 small government-owned utilities will bear costs greater than 1 percent of annual revenues in either the first or subsequent reporting years.

S.6.2 IMPACTS ON CERTAIN DEMOGRAPHIC GROUPS

By lowering the section 313 reporting thresholds for PBT chemicals, EPA will provide communities across the United States (including low-income populations and minority populations) with access to data that may assist them in lowering exposures and consequently reducing chemical risks for themselves and their children. This information can also be used by government agencies and others to identify potential problems, set priorities, and take appropriate steps to reduce any potential risks to human health and the environment. Therefore, the informational benefits of the final rule will have a positive impact on the human health and environmental impacts of minority populations, low-income populations, and children.

S.7 BENEFITS OF THE FINAL RULE

In enacting EPCRA and PPA, Congress recognized the significant benefits of providing information on the presence, release and waste management of toxic chemicals. TRI has proven to be one of the most powerful forces empowering the federal government, state and local governments, industry, environmental groups and the general public to fully participate in an informed dialogue about the environmental impacts of toxic chemicals in the United States. TRI enables interested parties to establish credible baselines, to set realistic goals for environmental

progress over time, and to measure progress in meeting these goals. The TRI system is a neutral yardstick by which progress can be measured.

The final rule to expand reporting on PBT chemicals will build upon the past success of TRI. Under current reporting thresholds, important information about the releases and other waste management activities involving PBT chemicals is not captured by the TRI. By lowering reporting thresholds for PBT chemicals, EPA will assure that the public will have access to such data.

The benefits of the final rule are related to the provision and distribution of PBT chemical information, and include improvements in understanding, awareness, and decision-making. The information reported to TRI increases knowledge of the levels of pollutants released to the environment and the potential pathways of exposure, thereby improving scientific understanding of the health and environmental risks of toxic chemicals; allowing the public to make better-informed decisions on matters such as where to work and live; enhancing the ability of corporate leaders and purchasers to gauge a facility's potential environmental liabilities; and assisting federal, state, and local authorities in making better decisions on acceptable levels of toxic chemicals.

Moreover, providing information can lead to follow-on activities that create additional costs and benefits. These follow-on activities, including reductions in releases of and changes in the waste management practices for toxic chemicals, yield health and environmental benefits. These changes in behavior come at some cost, and the net benefits of the follow-on activities are the difference between the benefits of decreased chemical releases and transfers and the costs of the actions needed to achieve the decreases.

Because the state of knowledge about the economics of information is not highly developed, EPA has not attempted to quantify the benefits of adding PBT chemicals to TRI or changing reporting thresholds. Furthermore, because of the inherent uncertainty in the subsequent chain of events, EPA has also not attempted to predict the changes in behavior that result from the information, or the resultant net benefits, (i.e., the difference between benefits and costs). EPA's benefits analysis, however, does provide illustrative examples of how the final rule will improve the availability of information on PBT chemicals.

CHAPTER 1
BACKGROUND, STATEMENT OF NEED, STATUTORY AUTHORITY AND OVERVIEW OF ANALYSIS

The Emergency Planning and Community Right-to-Know Act (EPCRA), also known as Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), created a broad range of emergency response planning and reporting requirements for manufacturers, processors, and users of toxic chemicals in the United States. Under section 313 of EPCRA, certain facilities are required to submit annual reports to the United States Environmental Protection Agency (EPA) and to States on their release(s), transfer(s), and waste management activities for certain toxic chemicals if they are manufactured, processed, or otherwise used above thresholds amounts. In addition, the Pollution Prevention Act (PPA) of 1990 requires these same facilities to report prevention, recycling, and other waste management information for these same chemicals. EPA maintains the data collected under EPCRA section 313 and the PPA in a database known as the Toxics Release Inventory (TRI).[1]

EPCRA section 313(f)(1) contains default reporting thresholds for facilities. These reporting thresholds are 25,000 pounds for toxic chemicals that are manufactured (including imported) or processed, and 10,000 pounds for toxic chemicals that are otherwise used. Facilities that meet these reporting thresholds, as well as other reporting criteria, are required to submit annual reports. EPA has determined that lower reporting thresholds are appropriate for TRI chemicals that persist and bioaccumulate in the environment, and therefore has decided to exercise its authority under section 313(f)(2) to revise the reporting thresholds for these chemicals. In addition, EPA is making other modifications to ensure meaningful reporting of persistent bioaccumulative toxic chemicals.

This report analyzes the economic impacts of adding chemicals to the EPCRA Section 313 list of toxic chemicals and modifying reporting requirements for persistent bioaccumulative toxic (PBT) chemicals. To understand the effects of the final rule, however, it is first necessary to understand how EPCRA section 313 and TRI currently operate. This chapter provides that background information. It begins with a description of the statutory and regulatory history of TRI, followed by a summary of the TRI reporting requirements and how the data have been used. The chapter concludes with a description of the need for TRI, and the statutory authority for expanding the program.

[1] The term *EPCRA section 313* properly refers to only the statutory requirements, while the term *TRI* properly refers to the database where the information collected under section 313 and under section 6607 of the PPA is stored. However, the terms have often been used interchangeably by the public to refer to the statute, the regulatory requirements, the reporting form, the database, and EPA's program to manage the data. In deference to common usage, the terms EPCRA section 313 and TRI are sometimes used interchangeably in this report where doing so will make the report simpler and easier to read.

1.1 STATUTORY AND REGULATORY HISTORY

1.1.1 PASSAGE OF EPCRA

In 1986, Congress passed EPCRA, which is also known as Title III of SARA. The law was passed in response to the accidental release of methyl isocyanate gas in Bhopal, India in December, 1984, and a number of chemical accidents in the U.S., including one in Institute, West Virginia. These accidental releases highlighted the dearth of information available to the public about toxic chemicals being manufactured, processed, used and transported within their communities. EPCRA is based on the premise that the public has the right to know about chemical uses, as well as routine and accidental releases. The broad purposes are to encourage planning for response to accidental chemical releases as well as daily management of routine releases, and to provide the public and government agencies with information about the presence, release and management of toxic chemicals.

EPCRA contains four main provisions:

- Planning for chemical emergencies (sections 301-303);
- Emergency notification of chemical accidents and releases (section 304);
- Reporting of hazardous chemical inventories (sections 311-312); and
- Toxic chemical release reporting (section 313).

Because the rule is being enacted under section 313 (and not the other sections of EPCRA), the remainder of this overview deals only with section 313 (i.e., TRI).

1.1.2 OVERVIEW OF TRI

EPA promulgated the regulations implementing EPCRA section 313 on February 16, 1988 (53 FR 4500) and they are codified at 40 CFR Part 372. Under these regulations, owners or operators of covered facilities must complete the Toxic Chemical Release Inventory Reporting Form R, which includes information on releases to air, water and land, as well as on-site waste treatment and transfers of the chemical in or as waste to off-site locations. These reports must be submitted to EPA and the States for each calendar year, by July 1 of the following year.

A completed Form R must be submitted for each toxic chemical manufactured, processed, or otherwise used at each covered facility as described in 40 CFR Part 372. There are currently over 600 toxic chemicals and chemical compound categories on the list of TRI chemicals.

A facility must report under section 313 if it meets all three of the following criteria:

(1) It is in a Standard Industrial Classification (SIC) code covered by the regulations;

(2) It has 10 or more full-time employees (or the hourly equivalent of 20,000 hours); and

(3) It manufactures, processes, or otherwise uses any of the listed toxic chemicals or chemical categories above the applicable reporting threshold.

TRI is unique among environmental databases because of the multimedia data it collects, and because it was designed for public access. EPCRA requires that EPA "establish and maintain in a computer database a national toxic chemical inventory based on data submitted to the Administrator." The Administrator shall make the data available by computer, telecommunication, and other means to any person on a cost reimbursable basis. EPA maintains the section 313 data in the national Toxics Release Inventory (TRI) database. TRI data are available to the public in a variety of paper and electronic formats, including disk, on-line, and CD-ROM.

Section 313(h) of EPCRA states that data obtained pursuant to section 313 are intended to provide information to the public as well as to Federal, State, and local governments. "These data shall be used to inform the public about releases to the environment of the listed chemicals; to assist government agencies, researchers, and other persons conducting research and gathering data; to aid in the development of appropriate regulations, guidelines, and standards; and for other similar purposes."

1.1.3 POLLUTION PREVENTION ACT

In 1990, Congress passed the Pollution Prevention Act (PPA), adopting as national policy an environmental hierarchy establishing pollution prevention as the first choice among waste management options. For waste that cannot be prevented at the source, recycling is considered the next best option. Treatment or disposal should be turned to only after source reduction and recycling have been considered. Section 6607 of the PPA augmented the information available to the public under EPCRA section 313 by requiring facilities to report information on their pollution prevention, recycling and other waste management activities on Form R. The data elements required by the Pollution Prevention Act are contained in section 8 of the Form R.

1.1.4 CHANGES TO THE LIST OF CHEMICALS

When Congress enacted EPCRA it gave EPA an initial list of approximately 300 chemicals and chemical categories subject to TRI reporting. The statutory list was derived from chemical

lists used in New Jersey and Maryland. Congress also included a provision in EPCRA to amend the list of chemicals. Under section 313(d), EPA has the authority to add a chemical to the list if it determines that the chemical can cause or can be reasonably anticipated to cause:

- Adverse acute human health effects at concentration levels reasonably likely to exist beyond facility site boundaries as a result of continuous or frequently recurring releases;
- Cancer or teratogenic effects, serious or irreversible reproductive dysfunctions, neurological disorders, heritable genetic mutations, or other chronic health effects; or
- A significant adverse effect on the environment.

EPA has also added chemicals to the list through its authority under section 313(d). Most notably, EPA added 286 chemicals and chemical categories to the list of toxic chemicals subject to TRI on November 30, 1994 (59 FR 61432). The majority of these chemicals are pesticides. Many of the remainder are chemicals regulated or identified as concerns under other environmental statutes such as the Clean Air Act, the Clean Water Act and the Safe Drinking Water Act.

EPA may delete a chemical from the list if it does not meet any of the above criteria. According to section 313(e) of EPCRA, any person may petition EPA to add or delete a chemical from the list on the basis of whether or not it meets the above criteria. All changes to the list are made through notice-and-comment rulemaking.

As described in Chapter 2, EPA is adding certain persistent bioaccumulative toxic chemicals to the list.

1.1.5 ALTERNATE THRESHOLD

On November 30, 1994, EPA finalized the "TRI Alternate Threshold for Facilities with Low Annual Reportable Amounts" (59 FR 61488). This rule was intended to reduce the compliance burden associated with EPCRA section 313. It established a streamlined reporting option for facilities where the annual reportable amount of a listed chemical released or managed does not exceed 500 pounds.[2] Such facilities have the option of applying an alternate manufacture, process or otherwise use threshold of 1 million pounds to that chemical, instead of the standard thresholds of 10,000 or 25,000 pounds. If a facility does not exceed the 1 million pound threshold, then that facility is eligible to submit Form A for that chemical instead of Form R.

[2] The annual reportable amount is equal to the combined total quantities recycled, combusted for energy recovery, treated or released. It can be calculated as the sum of data elements 8.1 through 8.7 on Form R.

Form A is a certification statement that includes facility identification information and the identity of the chemical or chemical category being reported. The Form must be submitted on an annual basis, and the information appears in the TRI data base in the same manner as information submitted on a Form R.

As described in Chapter 2, EPA is requiring reporting using the Form R only for certain TRI chemicals that persist and bioaccumulate.

1.1.6 EXECUTIVE ORDER 12856

On August 3, 1993, Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements" was signed by the President (58 FR 41981). The Executive Order requires federal facilities to comply with EPCRA requirements beginning with the 1994 reporting year. The Executive Order also asks all federal agencies to set a voluntary goal of 50% reduction from baseline quantities of their releases and transfers by 1999.

1.1.7 CHANGES TO THE LIST OF INDUSTRIES

On May 1, 1997, EPA finalized a rule adding facilities in seven industry groups to the list of facilities subject to the reporting requirements of section 313 (62 FR 23833). Prior to this action, reporting was limited to facilities in the manufacturing sector (SIC codes 20-39) and federal facilities. This action added facilities in the following sectors:

- SIC 10: metal mining (except 1011, 1081, 1094);
- SIC 12: coal mining (except 1241);
- SICs 4911, 4931, 4939: electric utilities (combusting coal or oil for the purpose of generating power for distribution in commerce);
- SIC 4953: commercial hazardous waste treatment;
- SIC 5169: chemicals and allied products-wholesale;
- SIC 5171: petroleum bulk terminals and plants-wholesale; and
- SIC 7389: solvent recovery services.

The first reports from these facilities will be submitted in 1999 and available to the public in 2000.

1.2 SUMMARY OF TRI REPORTING REQUIREMENTS

The previous section described the fundamentals of TRI reporting. This section provides a brief overview of several key requirements under the current TRI regulations. These descriptions are for the purpose of general background and are not comprehensive. This is not intended to serve as an official guidance document and should not be relied upon to determine applicable regulatory requirements. More information on specific requirements is available in EPA's "Toxic Chemical Release Inventory Reporting Form and Instructions," or from the Emergency Planning and Community Right-to-Know Information Hotline.

1.2.1 DEFINITION OF A FACILITY

EPCRA section 329 defines a facility to mean "all buildings, equipment, structures and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person."

1.2.2 FULL-TIME EMPLOYEE DETERMINATION

Facilities are only covered by TRI if they have 10 or more full-time employees (FTE) or the equivalent (20,000 hours, where a full-time employee is defined as 2,000 work hours per year). All employees, including part-time and on-site contract employees, must be counted in the FTE determination. Therefore, the FTE determination depends on the total number of hours worked during the year, and not on the actual number of persons working.

1.2.3 THRESHOLD DETERMINATIONS

Facilities must report to TRI if they manufacture, process, or otherwise use any of the listed chemicals above the reporting thresholds. For chemicals manufactured (including imported) or processed the current threshold is 25,000 pounds a year; for chemicals that are otherwise used the current threshold is 10,000 pounds a year. Threshold determinations for chemicals that are recycled or reused at the facility are based only on the amount of the chemical that is added during the year, not the total volume in the system. However, chemicals recycled off-site and returned to a facility are treated as the equivalent of newly purchased material.

The definitions of manufacture, process and otherwise use can be summarized as follows:

- **Manufacture** means to produce, prepare, compound or import a listed chemical, including coincidental production as a byproduct or impurity.
- **Process** means the preparation of a listed chemical, after its manufacture, for distribution in commerce. For instance, a company that combines resins, solvents, pigments and additives to produce paint is processing the constituent chemicals.
- **Otherwise Use** encompasses any activity involving a listed chemical that does not fall under the definitions of "manufacture" or "process". For example, lubricants, cooling fluids, refrigerants, hydraulic fluids, cleaners, degreasers and catalysts are typically otherwise used by the facilities that consume them. The definition of otherwise use includes stabilization, treatment for destruction and disposal of TRI listed chemicals a facility receives from off-site for the purpose of waste management and TRI listed chemicals manufactured in the course of such waste management activities.

As described in Chapter 2, EPA is lowering reporting thresholds for certain TRI chemicals that persist and bioaccumulate.

1.2.4 EXEMPTIONS

Under certain circumstances, a facility is not required to consider certain activities in its threshold and reporting calculations. The following are the current major exemptions from TRI reporting:

Use Exemptions. The following uses of listed chemicals are specifically exempted:

- **Use as a structural component of a facility.** For example, painting of the facility;
- **Use in routine janitorial or facility grounds maintenance.** Examples include bathroom cleaners and fertilizers or pesticides used to maintain lawns. The exemption applies only when the chemicals are used in the same form and concentration as commonly distributed to consumers;
- **Personal uses by employees or other persons.** For example, office supplies such as correction fluid and copier machine fluid;
- **Use for the purpose of maintaining motor vehicles operated by the facility.** This exemption includes such chemicals as brake and transmission fluids, oils and lubricants, antifreeze, batteries and cleaning solutions for purposes of motor vehicle maintenance; or
- **Chemicals contained in intake water or in intake air.** This exemption covers the use of toxic chemicals present in process water and non-contact cooling water as drawn from the environment or from municipal sources, or toxic chemicals present in air used either as compressed air or as part of combustion.

De Minimis. The amount of chemical present in a mixture or trade name product which is processed or otherwise used does not need to be counted towards threshold and reporting calculations if its concentration is less than 0.1 percent of the mixture for chemicals defined as carcinogens by the Occupational Safety and Health Administration (OSHA), or less than 1 percent of the mixture for all other chemicals. This exemption does not apply to the processing or otherwise use of TRI chemicals in waste streams because wastes are not considered to be mixtures or trade name products. The *de minimis* exemption also applies to TRI listed chemicals that are manufactured as an impurity, but does not apply to chemicals manufactured as byproducts (e.g., a toxic chemical that is separated from a process stream). As described in Chapter 2, EPA is eliminating the *de minimis* exemption for PBT chemicals.

Transportation. EPCRA provides an exemption from section 313 for the transportation of chemicals. According to section 327, only the emergency notification requirements in section 304 apply to the transportation of chemicals or their storage incidental to transportation. The conference report for EPCRA clarifies that the exemption relating to storage is limited to materials which are still moving under active shipping papers and which have not reached the ultimate consignee.

Articles. A facility is not required to account for chemicals in articles processed or otherwise used at the facility. An article is a manufactured item: (1) that is formed to a specific

shape or design during manufacture; (2) that has end use functions dependent in whole or in part upon its shape or design during end use; and (3) that does not release a toxic chemical under normal conditions of processing or otherwise use.

For example, a closed item containing a listed chemical (e.g., a transformer containing PCBs) that does not release the toxic chemical during normal processing or otherwise use activities may be considered an article. However, if the facility services the item (e.g., a transformer), any chemical added must be counted in threshold and reporting calculations.

Laboratory Activities. Chemicals that are used for research or quality control under the supervision of a technically qualified individual do not need to be counted. This exemption does not apply to pilot plant scale operations or laboratories that distribute chemicals in commerce.

1.2.5 USE OF READILY AVAILABLE DATA FOR REPORTING

According to section 313(g)(2) of EPCRA, no additional monitoring or measurement of quantities, concentrations, or frequency of release of any listed chemical may be required for the purpose of reporting to TRI. The required information may be obtained from readily available data that are collected pursuant to other provisions of law or as part of routine plant operations. When such data are not available, reasonable estimates, using such methods as published emission factors, materials balance calculations or engineering calculations, are sufficient.

1.2.6 OTHER

SIC Code Determination

Facilities are subject to TRI reporting if they are in a listed SIC code. This encompasses the following industry groups:

SIC Code	INDUSTRY GROUP
20-39	Manufacturing
10	Metal Mining (except 1011, 1081, 1094)
12	Coal Mining (except 1241)
4911, 4931, 4939	Electric Services (combusting coal and/or oil)
4953	Commercial Hazardous Waste Treatment (RCRA subtitle C only)
5169	Chemical and Allied Products - Wholesale
5171	Petroleum Bulk Stations and Terminals - Wholesale
7389	Solvent Recyclers only

Facilities with multiple SIC codes are covered if their primary SIC code is a listed SIC code. Some facilities have multiple establishments at the same site, with some establishments that are in SIC codes covered by TRI and others that are outside the covered SIC codes. Such facilities must calculate the value of products produced or shipped from each establishment within the facility. If establishments within covered SIC codes account for a either a majority or a

plurality of the total value of the products shipped from or produced at the facility, the entire facility meets the SIC code criterion. A covered multi-establishment facility must make threshold determinations and, if required, must report to TRI for the entire facility, even from establishments that are outside covered SIC codes.

Range Reporting

Facilities with total annual releases or off-site transfers of less than 1,000 pounds of a listed chemical can report these quantities in ranges (1-10 lbs, 11-499 lbs, or 500-999 lbs) instead of as point estimates. Range reporting lowers the reporting burden for these facilities. As described in Chapter 2, EPA is requiring point estimates for certain PBT chemicals.

Recordkeeping

Facilities must keep a copy of each report filed for at least three years from the date of submission. Facilities must also maintain those documents, calculations, worksheets, and other forms upon which they relied to gather information for their reports. EPA may request documentation to support submitted information or conduct data quality reviews of submissions.

Chemical Categories

A chemical category contains several individual chemicals having similar characteristics and is considered to be one chemical for the purpose of TRI reporting. EPCRA section 313 requires threshold determinations for chemical categories to be based on the total amount of all chemicals in the category. For example, a facility that manufactures three members of a chemical category would count the total amount of all three chemicals manufactured towards the manufacturing threshold for that category. When filing reports for chemical categories, the releases are determined in the same manner as the thresholds. One report is filed for the category and all releases are reported on this form.

About half of the categories are for metal compounds. These compounds generally contain unique chemical substances that contain the parent metal as part of that chemical's infrastructure. For instance, the arsenic compounds category includes any chemical substance containing arsenic, and the lead compounds category contains any chemical substance containing lead. Some categories are limited to a class of chemicals. For instance, the cyanide compounds category includes any unique chemical described by X^+CN^- where $X=H^+$ or any other group where a formal dissociation may occur (for example KCN or $Ca(CN)_2$). Other categories (for instance polycyclic aromatic compounds) are delimited—only certain listed chemicals are included under the category designation.

Most chemical categories are made up of chemicals that are structurally similar or contain similar functional groups and that cause similar toxic effects. For example, the polycyclic aromatic compounds category contains chemicals that are structurally similar and have the same

toxicity concern (cancer). However, the chemicals in the metal compounds categories have widely varying structures but they all contain the same metal component which has the same toxicity concern.

Trade Secrets

A facility may claim the specific identity of a chemical as a trade secret, but the rest of the report (whether Form R or certification statement) must be completed. To make a trade secrecy claim, the facility must submit two versions of the report (one that identifies the chemical and the other with generic chemical identity instead of the real chemical name) and a trade secret substantiation form. Examples of generic chemical identities might include ketone (for methyl ethyl ketone), mineral acid (for nitric acid) or CFC (for dichlorodifluoromethane). Since there are multiple chemicals on the section 313 list that could be described by one of these generic identities, the specific identity of the chemical would not be disclosed.

1.3 PUBLIC ACCESS TO AND USES OF THE TRI DATA

Section 313(h) states that data obtained pursuant to section 313 are intended to provide information to the public as well as to Federal, State, and local governments. The TRI program serves the important function of making data available to inform the public about releases to the environment of the listed chemicals; to assist government agencies, researchers, and other persons conducting research and gathering data; to aid in the development of appropriate regulations, guidelines, and standards; and for other similar purposes. Data submitted to EPA in compliance with section 313 are maintained in the national Toxics Release Inventory (TRI) data base, and are accessible to any person on a cost-reimbursable basis.

EPA makes the TRI data available through a variety of formats including hard copy of Form R reports, annual reports summarizing TRI data nationally and state-by-state, CD-ROM, and through the Internet. With its broad dissemination, TRI data has enjoyed extensive use by the public. Facilities have used the data obtained through TRI to better understand their operations, and make better use of pollution prevention opportunities. Public-interest groups have used the data to educate themselves on the presence of toxic chemicals in the environment, and have used that increased information to engage in meaningful, productive dialogue with industry and with all levels of government. In general, TRI data has proven to be a powerful tool in environmental decision making.

1.4 STATEMENT OF NEED

Federal regulations often are used to address significant market failures. Markets will fail to achieve socially efficient outcomes when differences exist between market values and social values. One type of market failure occurs when one party's actions impose uncompensated costs or benefits on another party outside the marketplace. For example, a manufacturing facility releasing toxic chemicals to the environment may impose environmental and health risks on the

residents of the adjacent community without compensating for those risks. Although created by the manufacturing facility, it is the community rather than the facility that bears the cost of these risks. The EPCRA section 313 reporting requirements were designed to address this market failure, at least in part, by providing information to the public and federal, state, and local governments regarding the release of over 600 chemicals and chemical categories to the environment. The public is expected to use this information in three important ways. First, the public will use the information to make better informed decisions on where to work and live. Second, as consumers they will use this information to differentiate between the products they purchase thus bringing economic pressure to bear on polluting companies. Third, they will use information on chemical releases to encourage polluting companies to reduce their releases of toxic chemicals. Governments will use the information to identify hot spots, set priorities, evaluate ecological and human health risks, and design better, more informed regulations. In addition, elements of society apart from government and the public may use the information to make decisions. For example, the information enhances the ability of corporate lenders and purchasers to more accurately gauge a facility's potential environmental liabilities.

The following discussion first provides a review of the theory of market failure and how it can be corrected, and then describes the role that TRI can play in correcting a specific market failure.

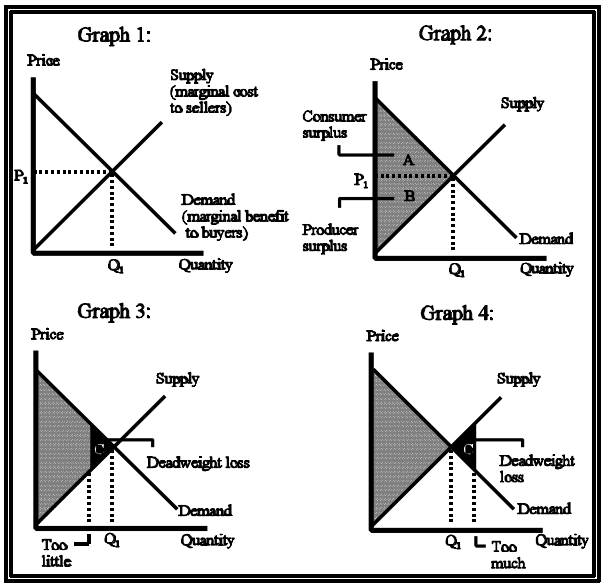
1.4.1 THE THEORY OF MARKET FAILURE

The theory of modern welfare economics states that allocative efficiency is achieved when it is impossible to change the allocation of resources in such a way as to make someone better off without making someone else worse off. More precisely, economic theory states that allocative efficiency occurs where consumers' marginal benefit exactly equals producers' marginal cost (Samuelson and Nordhaus, 1985). Graph 1 (Figure 1-1) illustrates the efficient allocation of resources. Where the two curves cross, the price is such that demand equals supply and the benefit from consuming that amount exactly matches the cost of producing it. If output were higher, the cost of producing any additional units will exceed their marginal value. Conversely, any decrease in the number of units produced will result in a situation where the benefit of consuming more will exceed the costs of production.

In Graph 2 (Figure 1-1), the upper shaded area indicates the difference between the price consumers actually pay for a good and the price consumers would have been willing to pay rather than do without. This difference is known as consumer surplus (area A). The lower region

reflects the producer surplus (area B): revenues received less the costs of production. The total welfare gain (consumer and producer surplus) due to the production and consumption of this good is maximized at the efficient quantity Q_1. If the economy fails to achieve this efficient output, society suffers a loss in potential welfare, what economists call a deadweight loss. Graphs 3 and 4 (Figure 1-1) illustrate the deadweight loss (area C) incurred from producing too little or too much of a good, respectively.

FIGURE 1-1: MARKET EFFICIENCY

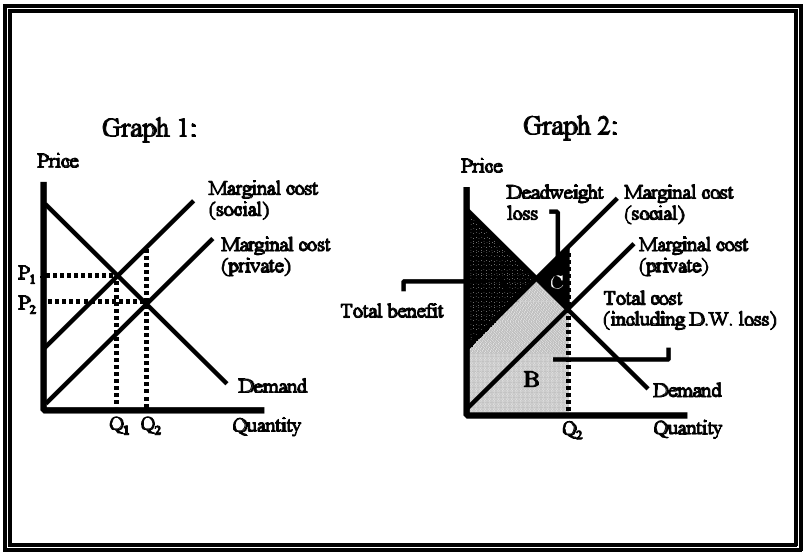


The allocation of resources generated by the interaction of supply and demand, however, will not always be desirable from the standpoint of society. The market will fail to achieve a socially efficient outcome when differences exist between market values and social values. The economic literature identifies four causes of market failure: externalities, public goods, market power (i.e., monopoly, monopsony, and oligopoly), and information asymmetries. The following discussion focuses on externalities and information asymmetries.

In the case of externalities, one party's actions impose uncompensated benefits or costs on another party. For example, in the performance of manufacturing and other business activities, entities may release pollution or cause other environmental harm without accounting for the consequences of these actions on other parties such as members of the local community. These costs are not recognized by the responsible entity in the conventional market-based accounting framework. For example, a company that produces and/or uses hazardous chemicals will pay for labor and capital but will not pay for environmental damages resulting from their emissions of these hazardous chemicals. Because these costs are not recognized by the responsible entity, they are not considered in the consequent production and pricing decisions of the firm. Economists refer to such costs as external costs or externalities.[3] To the extent that these externalities are negative (i.e., impose costs on society), an overproduction and overuse of environmentally hazardous chemicals will occur and an inefficient level of environmental quality will result (Mills and Graves, 1986). One approach to addressing such an externality would be to reduce production of environmentally hazardous chemicals at the firm. A second approach would involve the adoption of pollution prevention practices which might or might not also reduce production at the firm, depending on whether or not the pollution prevention practices result in efficiency gains and the firm's ability to pass on the cost of pollution prevention to consumers.

[3] The origin of modern externality theory can be traced back to John Stuart Mill's *Principles of Political Economy*, Alfred Marshall's *Principles of Economics*, and A.C. Pigou's *Wealth and Welfare*.

FIGURE 1-2: SOURCES OF MARKET FAILURE



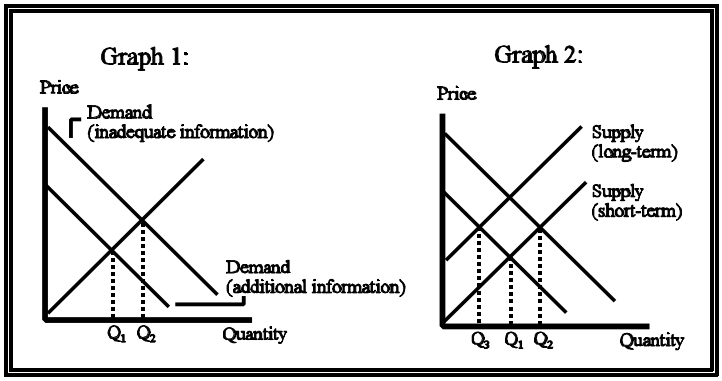
Graph 1 (Figure 1-2) illustrates the over-production of goods due to the existence of external costs. The private marginal cost curve differs from the social marginal cost curve (private costs + external costs). The distance between the social marginal cost curve and the private marginal cost curve represents the cost to society imposed by the externality. The outcome is a pricing structure such that Q_2 units are produced at price P_2. If the external costs were fully internalized and producers were in fact operating on the social marginal cost curve, the *socially* efficient quantity Q_1 would result and consumers would pay a higher price at P_1.[4] The social loss associated with the production of Q_2 is shown by the dark shaded area (area C) in graph 2 (Figure 1-2) which corresponds to the amount of over production that results from producers operating on the private marginal cost curve instead of the social marginal cost curve. The deadweight loss is the difference between total costs (area B and C) and total benefits (area A). This is the same deadweight loss that was illustrated in Graph 4 (Figure 1-1).

The market may also fail to efficiently allocate resources in cases where consumers systematically lack perfect information. In economic theory, perfect information among buyers and sellers is required for individuals to make rational decisions and for resources to be efficiently allocated. There are at least three ways in which information is not, in fact, perfect, which potentially diminishes the efficiency of individuals' decisions: 1) there may be variation in the amount of information held by different market participants (producers and consumers), affecting their potential to realize gains from trading; 2) there may be uncontrollable uncertainty that affects all outcomes, such as how much rainfall will be available to grow a particular crop; and 3) consumers may not have sufficient information regarding the consequences of their decision to make rational decisions, and may or may not be aware of the limitations of the information they do have. This discussion is limited to the third type of imperfect information. Lacking full information of the consequences of their purchases, consumers may over-value or under-value the goods in question. When consumers lack information regarding the negative consequences of their purchases, the result will be a misallocation of resources due to excess demand. For example, increased awareness of the health hazards associated with smoking has resulted in a

[4] It should be noted, however, that producers may be able to reduce the externality without decreasing production all the way to Q_1. If a producer adopts pollution prevention practices that result in efficiency gains, the externality can be reduced without reducing the quantity produced. In this case, the social marginal cost curve would shift closer to the private marginal cost curve.

permanent decrease in the demand for cigarettes (Parkin, 1990). While producers have a strong incentive to inform consumers of the positive aspects of their products in order to increase demand, they do not ordinarily have an incentive to furnish consumers with information regarding the negative consequences associated with their products' use or production, such as the release of toxic chemicals to the environment.

FIGURE 1-3: INFORMATION PROVISION AND EFFICIENCY



Graph 1 (Figure 1-3) illustrates a shift in demand and reduction in the production quantity due to the provision of information. When furnished with full information, consumer demand shifts inward, resulting in a short-term pricing structure such that the quantity Q_1 is produced. Following a permanent decrease in demand, the market price will fall and some firms will leave the industry. As producers leave the industry, the supply curve shifts to the left and the equilibrium price will gradually rise back to its original level as the market returns to a state of long-term equilibrium (Parkin, 1990). Graph 2 (Figure 1-3) illustrates this shift in supply resulting in a further reduction in the efficient quantity to Q_3. This long-term equilibrium will result as consumers respond to full information by changing their purchasing decisions (increasing or decreasing their consumption), by changing the way they use a product, or by altering their choice of where to live and work.

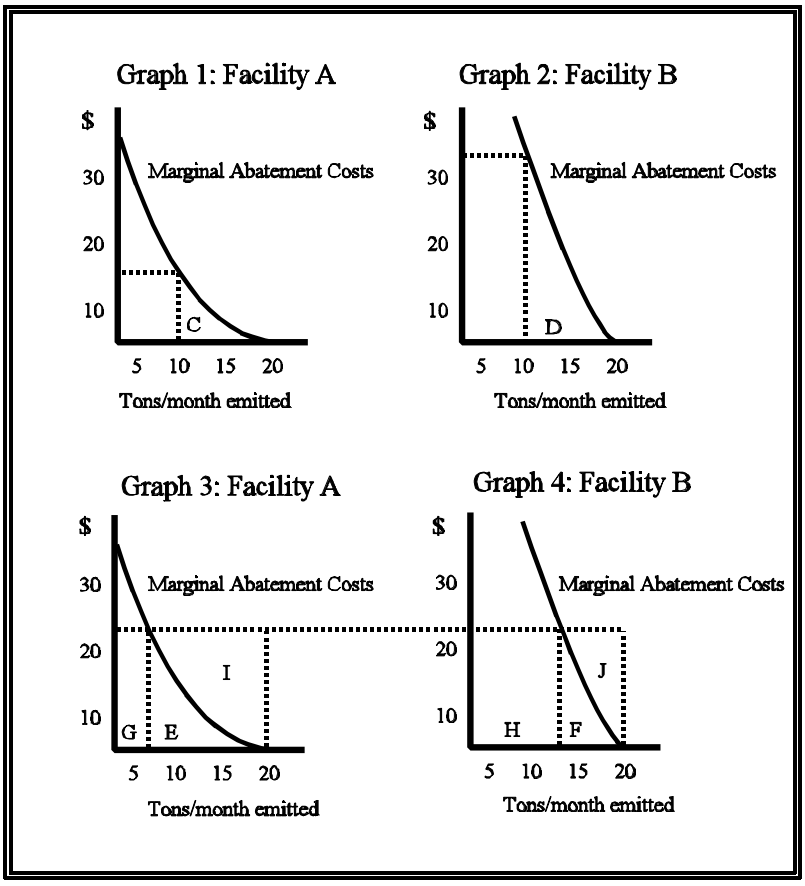
In the event of a significant market failure, public intervention is often required to override the market directly or to configure market incentives in order to achieve a more socially efficient outcome.[5] Several alternative approaches are available to address market failure and to move society closer to an efficient allocation of resources: command-and-control (C&C) strategies, incentive-based strategies, and information-based strategies. C&C strategies tend to be less

[5] Economists have argued that it is theoretically possible for the firm to negotiate with members of the community about payments to compensate them for the damages they suffer, yielding an efficient distribution of resources even in the presence of externalities (Davis and Hulett, 1977). In his article *The Problem of Social Cost*, R. H. Coase suggests that public intervention is not necessary to correct market imperfections because the affected party may be able to pay the producer of the externality to reduce their activities which result in external costs or to implement pollution controls. Theoretically, the affected party would be willing to offer a "bribe" for incremental pollution reductions up to the point where marginal abatement costs and marginal damages are equal. Both parties would be better off up to this point because the incremental payments made by the affected party will not exceed their marginal damages (the affected party benefits) and the payments received by the firm will exceed their marginal costs of pollution abatement (the polluter benefits). A *socially* efficient level of production is achieved (the equity implications of this solution are not factored into this outcome). For the proper operation of the Coase Theorem, several conditions (which are often unmet in cases of environmental pollution) must be present: 1) property rights must be well defined, enforceable, and transferable; and 2) transaction costs must be minimal in order to allow negotiation to occur (Field, 1994).

sensitive to differences in costs and benefits across polluters by setting standards for the quantities of pollutants a source may release. This approach is typically implemented by mandating specific control technologies (design standards) or specific environmental targets (performance standards). C&C strategies have been widely criticized within the economic literature on several grounds. By imposing a uniform standard across all facilities without consideration of the relative costs of emissions control, the standards approach forgoes possible savings that could be achieved by reallocating emissions reductions among firms in such a way as to achieve the same overall reductions but at a lower cost.

Figure 1-4 illustrates the inefficiency of a standard as it applies to two facilities (A and B). Graphs 1 and 2 illustrate the marginal abatement costs — the added costs of achieving a one-unit decrease in emission level — faced by facilities A and B .[6] In both cases, marginal abatement costs increase as greater emission reductions are achieved. Also, marginal abatement costs for any level of emissions are lower for facility A. This situation may result because facility B is older and more expensive to retrofit with pollution control devices. Because marginal abatement costs vary between facility A and B, the standards approach, whether design standards or performance standards, will fail to minimize total abatement costs. Assuming that a maximum emission limit of 10 tons/month is set for each facility, facility A will incur compliance costs equal to area C (Graph 1) and facility B will incur compliance costs equal to area D (Graph 2). However, emission reductions can be reallocated between facilities A and B in such a way as to achieve aggregate abatement costs lower than area C + D. Graphs 3 and 4 illustrate the most efficient (i.e., least cost) allocation that still reduces emissions to 20 tons/month. By reducing emissions to roughly 6 tons/month at facility A and roughly 14 tons/month at facility B, aggregate abatement costs (E

FIGURE 1-4: THE INEFFICIENCIES OF STANDARDS



[6] Graphs in Figure 1-4 should be read from right to left, with marginal abatement costs increasing as greater emission reductions are achieved. The area below the marginal abatement cost curve indicates the total costs of abatement. Left unregulated facility A and B will each release 20 tons/month of emissions.

+ F) are minimized. In all cases, aggregate abatement costs across firms are minimized where marginal abatement costs are equal (in graphs 3 and 4, roughly $21).[7] Total reductions are equal to those achieved under the uniform standard (i.e., 20 tons/month), however, total abatement costs are minimized. We will see below that the incentive approach creates a mechanism by which emission reductions occur at least cost by equalizing marginal abatement costs across firms.

Thus far, the discussion has focused on the inefficiency of a uniform standard in achieving a specific emission level. This is a question of cost-effectiveness—does our regulatory approach achieve a given emission level at least cost? In order to insure an efficient allocation of resources, however, emissions must not only be reduced at least cost but must also be reduced to a socially efficient level. Recall that the efficient allocation of resources occurs where marginal benefits equal marginal social costs (Figures 1-1 and 1-2). If a standard is set such that emissions are too high or too low, a deadweight loss will result. In Figure 1-4, emissions were reduced to 20 tons/month. In order to determine if 20 tons/month is the efficient level of emissions, the regulating agency requires data to estimate the shapes of the aggregate marginal cost curve as well as the aggregate marginal benefit curve. Information such as total releases, marginal abatement costs, and human and environmental damages are required to estimate an efficient level of emissions. Assuming that 20 tons/month is the socially efficient level, Figure 1-4 illustrates that a uniform standard may achieve efficiency, but will not do so at least cost.

In addition to their efficiency short-comings, command-and-control strategies will sometimes discourage technological innovation or create a weaker incentive for innovation than the incentive-based approaches discussed below. In the case of a technology based standard, firms will tend to adopt the technology represented by the standard regardless of whether a better (i.e., less expensive) alternative exists. Better to insure compliance than attempt to justify the merits of an alternative approach. In the case of a technology based standard, no incentive exists for research and development (R&D). When faced with a performance standard, the incentive for engaging in R&D equals any avoided compliance costs; however, as we will see below, this is a weaker incentive than is created by the incentive approach (Field, 1994). Both the incentive approach as well as the information based strategies have advantages compared to the standards approach.

Incentive strategies, rather than mandating a uniform standard across all generators, place a price on every unit of pollution creating an incentive for emitters to reduce their emissions. The most common approach is to set a charge per unit of pollution; however, other alternatives are also suggested in the literature, including tradeable discharge permits and abatement subsidies (Field, 1994). The following discussion focuses entirely on emissions charges, however, the general theory is applicable to all incentive strategies.

---

[7] The equimarginal principle states that aggregate costs across facilities are minimized where marginal costs are equal. The principle is not only relevant to pollution abatement costs, but also applies to any situation in which marginal costs vary. For example, a shoe manufacturer that operates multiple facilities may ask how to allocate production of 10,000 shoes across 12 different facilities while minimizing aggregate production costs. The answer is to allocate their production such that marginal costs are equal across all facilities (Field, 1994).

Several studies have been conducted supporting the efficiency advantages of incentive strategies while simultaneously revealing the unnecessary costs imposed by the command and control approach. The most widely known sources include: *Pollution, Prices, and Public Policy* by Allen Kneese and Charles Schultze, *The Public Use of Private Interest* by Charles Schultze, and *Economics of the Environment*, a collection of essays edited by Robert and Nancy S. Dorfman. Incentive type approaches are able to reduce the same quantity of emissions at a lower cost compared to command-and-control strategies because an incentive is created for reductions to occur where it is least costly to do so. For example, a charge per ton of SO_2 will create an incentive for firms to reduce their emissions until their marginal cost of reducing one additional ton exceeds the per ton emissions charge. Firms that can economically reduce their SO_2 emissions will do so, while others may choose to incur the cost of the fee. Higher emission charges will induce greater emissions reductions and a reduction in the emissions charge will increase emissions.

Returning to Graphs 3 and 4 (Figure 1-4), it can be seen that an emissions charge will automatically lead to the most efficient allocation of emissions reductions (i.e., where marginal abatement costs are equal). By establishing a fee of $21/ton/month, an incentive is created for facility A to reduce emissions to roughly 6 tons/month. By reducing emissions to 6 tons/month, facility A incurs total fee payments equal area G and total abatement costs equal to area E. If facility A were to continue emitting 20 tons/month and incur the entire cost of the fee, total fee payments would equal area G + E + I. Assuming that facility A and B are operating in a competitive market with perfect information, they will reduce their emissions up to the point where marginal abatement costs are equal to the per ton fee, effectively minimizing their total costs (i.e., emissions fee plus abatement costs). Facility B, operating under the same competitive pressures, will reduce emissions to roughly 14 tons/month, incurring costs equal to area H (fee payment) and F (abatement cost). Because of the incentive created by an emissions fee, emission reductions will automatically be allocated such that abatement costs are minimized. In addition, the incentive to engage in research and development efforts is stronger under an emissions fee compared to a standard. Recall that the incentive for R&D under an emissions standard is equal to avoided compliance costs. In contrast, the incentive to engage in R&D under an emissions fee is equal to avoided compliance costs plus any avoided fee payments.

While an emissions charge will insure that reductions occur at least cost, it will not insure a socially efficient allocation of resources. In order to achieve an efficient allocation of resources, an emissions fee must be set such that marginal benefits equal marginal social costs. If an emissions fee is set too high or too low, a deadweight loss will result. As with the standards approach, the regulating agency requires data in order to estimate the shapes of the aggregate marginal cost curve and the aggregate marginal benefit curve. An alternative option would be to establish an emissions fee, then observe ambient pollution levels and determine if a socially efficient outcome results. If ambient pollution levels decrease by too much or too little, the fee would then be lowered or raised as appropriate. Such an approach, however, is likely to be enormously disruptive to industry. Industry is likely to respond to an emissions charge by

investing in costly pollution-control technology. Any changes in the emissions fee are likely to disrupt capital investment plans, placing a further premium on accurate data to estimate an appropriate emissions charge from the beginning. Although an emissions fee may not always achieve an efficient level of pollution, it will allocate reductions at least cost.[8]

The third approach to addressing the existence of externalities is information-based strategies. As in the case of incentive strategies, information-based strategies provide a more market oriented alternative to command-and-control approaches. Specifically, they can lead to more cost-effective reductions in chemical emissions by allowing facilities the flexibility to decide whether and how to make reductions. The various approaches are quite varied: government testing and rating systems, mandatory disclosure requirements such as labeling and periodic reporting, and government provision of information. As illustrated above, the provision of information works to internalize costs by informing consumers of the external economies and diseconomies associated with their purchasing decisions.[9] Consumers may respond to the additional information by changing their purchasing decisions (increasing or decreasing their consumption), by changing the way they use a product, or by altering their choice of where to live and work.[10] In cases where the market is unlikely to provide adequate information, public intervention is sometimes required to provide consumers with information that will allow them to make these decisions efficiently.

1.4.2 THE EFFECT OF TRI INFORMATION ON MARKET FAILURE

Through the provision of toxic chemical release data, the Toxics Release Inventory (TRI) overcomes firms' disincentive to provide information on their toxic releases and moves society toward an efficient allocation of resources in three important ways:

1) *By allowing more informed decisions to be made by society, consumers, and corporate lenders, purchasers and stockholders*. According to OMB guidance, "If intervention is necessary to address a market failure arising from inadequate information, informational remedies will generally be the preferred approaches. As an alternative to a mandatory standard, a regulatory measure to improve the availability of information has the advantage of being a more market-oriented approach. Thus, providing consumers information about concealed characteristics of consumer products gives consumers a greater choice than banning these products" (OMB, 1996).

---

[8] In contrast, an emissions standard will not always achieve an efficient level of pollution and is unlikely to allocate reductions at least cost. In order for an emissions standard to minimize abatement costs, all facilities must operate under the same marginal abatement cost structure.

[9] Provision of information may be at least one step removed as in the case where the hazard associated with a product may be attributable to an input, not the final product.

[10] Information provision may also influence how consumers allocate their time, in addition to how they allocate their purchasing decisions. For example, information regarding the health benefits of regular exercise may encourage consumers to allocate more of their time to exercise.

In the case of toxic chemical releases, however, it is not just consumers that are affected.[11] Rather, society at large is affected by the release of toxic chemicals into their communities. It is individuals in society that bear the burden of the externality and individuals in society that require information on toxic chemical releases in order to make rational decisions regarding such things as where to live and work.

By informing society of the toxic chemical releases in their communities, an incentive is created for industry to reduce emissions. Release data holds the potential to adversely affect a company's public image and companies may respond to that possibility whether their concern be real or perceived. Santos, Covello, and McCallum surveyed 221 facilities subject to TRI reporting and found that nearly all facilities had reported reduced emissions and half had increased their environmental communication activities despite the fact that public inquiries did not increase. The authors interpret their results as an indication that the mere potential for adverse public reaction may provide an important motivator for emissions reductions (Santos et al., 1996). Information provision will not correct the entire market failure. However, to the extent that companies "perceive" that their public image will be adversely affected by the public dissemination of toxics release data, they will respond by reducing emissions. Concerns are most likely to exist when facility releases per unit of production (which can be calculated using TRI data in conjunction with production data) are higher than average within their industry or releases are increasing over time. Such determinations could not be made without the inter-temporal and inter-facility data provided by TRI.

In addition to informing affected communities and consumers, the information provided by TRI enhances the ability of corporate lenders, purchasers, and stockholders to more accurately gauge a facility's potential environmental liabilities, again resulting in better-informed decision making. Investors who are unaware of a firm's emissions may overvalue their stock because they have inadequate information regarding the company's potential liability, abatement expenditures, and fines. Better information will help stockholders to more accurately value the stock (see Hamilton, 1995).

2) *By providing vital information for the efficient design and targeting of federal, state, and local enforcement and regulatory programs*. Toxic chemical release data is used by governments to identify hot spots, set priorities, and monitor trends, all of which can yield more informed decisions. For example, EPA's Office of Air and Radiation (OAR) has used TRI data for a variety of tasks related to the implementation of the Clean Air Act Amendments of 1990 (CAAA): 1) TRI data have been used in setting research priorities for the 189 Hazardous Air Pollutants (HAPs) identified in the CAAA; 2) TRI data are used by OAR to target potential sources for inclusion in the Early Reductions Program (a means of achieving enforceable reductions of toxic emissions before a regulation is in place); and 3) TRI facility-level locational data are being used in conjunction with other demographic data to improve exposure assessment (U.S. EPA, 1995). The TRI is unique in that it allows comparisons between firms within the

[11] TRI data does not provide total chemical releases for a consumer ready product, therefore, demand changes attributable to TRI are assumed to be limited. In addition, the external costs of toxic chemical releases are not always borne by the consumer of the product, further diminishing the likely impact on consumer demand.

same industry as well as across industries, again yielding better-informed decisions in the design of regulations as well as in the development of voluntary programs. Moreover, because of the way the information is disseminated, such decisions do not have to be made by the federal government, but can also occur at the state or local level. TRI data will not fully internalize the external costs associated with the release of toxic chemicals; however, to the extent that TRI contributes to the efficient design of new regulations and voluntary programs, external costs are likely to be addressed in an efficient manner.

3) *By informing facilities of opportunities to reduce emissions*. TRI information provides facilities themselves with important information for judging their own performance and may alert them to opportunities for the implementation of pollution prevention or recycling projects. In some cases, firms may change their behavior by increasing recycling or treatment efforts without affecting the marginal costs of production. Behavioral changes will be in the firms' own self-interest by minimizing the cost of production. In such cases, emissions may be reduced without any affect on consumption.

While the TRI does provide information on chemical releases, it does not provide any information on the costs associated with the externalities created by such releases. However, the dissemination of information through TRI mitigates two causes of market failure: incomplete information and externalities. By addressing these market failures, TRI moves society closer to an efficient allocation of resources and increases social welfare. Addressing market failure through information provision avoids inefficiencies inherent in command and control regulations. Also, to the extent that TRI informs regulating agencies of the marginal costs and benefits associated with the release of toxic chemicals, inefficiencies associated with incentive strategies may be avoided.

1.5 STATUTORY AUTHORITY

EPCRA section 313 contains default reporting thresholds, which are set forth in section 313(f)(1). Section 313(f)(2) allows EPA to "establish a threshold amount for a toxic chemical different from the amount established by paragraph (1)." The amounts established by EPA may, at the Administrator's discretion, be based on classes of chemicals or categories of facilities. There are no requirements that trigger EPA's authority to revise the reporting thresholds, nor is the Agency required to exercise that authority under any particular circumstances. Instead, section 313(f)(2) is a broad authority that EPA may use as appropriate, in EPA's judgment, to set thresholds for particular chemicals, classes of chemicals, or categories of facilities.

1.6 PURPOSE AND SCOPE OF THIS REPORT

This report examines the increase in reporting that will result from modifying the TRI program to obtain additional reports on PBT chemicals. The specific modifications to the TRI program are described in detail in Chapter 2.

1.7 ORGANIZATION OF THIS REPORT

This report examines the potential increase in reporting that would result from adding certain PBT chemicals, lowering reporting thresholds for PBT chemicals, and other modifications to reporting requirements. This report also estimates the costs to industry and EPA associated with the reporting burden and other impacts of the rule. The remainder of this report is organized as follows:

- **Chapter 2** describes the regulatory options and modifications to reporting requirements considered by EPA.
- **Chapter 3** summarizes the expected number of reports and facilities affected by the final rule.
- **Chapter 4** presents the methodology used to estimate the costs and the results of the analysis in terms of total cost to industry and total cost to EPA.
- **Chapter 5** examines the impacts of the final rule, including those impacts on "small" entities as required by the Regulatory Flexibility Act of 1980.
- **Chapter 6** evaluates the benefits of additional reporting on PBT chemicals.
- **Appendices**. These appendices describe in detail the analysis performed to develop estimates of the number of reports and affected facilities for each PBT chemical or chemical category.

LITERATURE CITED

1. Agee, Mark D. and Thomas D. Crocker. "Parental and Social Valuations of Child Health Information" (1994). Journal of Public Economics 55, 89-105, 1994.

2. Baumol, William J.. The Theory of Environmental Policy: Externalities, Public Outlays, and the Quality of Life (1975). Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1975

3. Bergeson, Lynn L. And Lisa M. Campbell. "Economic Incentives for TQEM: Are They in Your Future?" (1991-2) Total Quality Environmental Management, Volume 1, Number 2, Winter 1991-2.

4. Burrows, Paul. The Economic Theory of Pollution Control. Cambridge, Mass.: The MIT Press. 1980

5. Coase, R. H. "The Problem of Social Cost." (1960) *Journal of Law and Economics* 1 (October): 1-44, 1960.

6. Cowen, Tyler. The Theory of Market Failure: A Critical Examination (1988). Fairfax, VA,: George Mason University Press, 1988.

7. Davis, J. Ronnie and Joe R. Hulett. An Analysis of Market Failure: Externalities, Public Goods, and Mixed Goods. Gainesville: University Press of Florida. 1977.

8. Dorfman, Robert and Nancy Dorfman. Economics of the Environment: Selected Readings. New York: Norton. 1972.

9. Field, Barry. Environmental Economics: An Introduction. McGraw-Hill, Inc. 1994

10. Hamilton, James T. "Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data." (1995) Journal of Environmental Economics and Management 28, 98-113, 1995.

11. Hochman, H. M. And J. D. Rogers. "Pareto Optimal Redistribution." (1969) American Economic Review, September, 1969.

12. Kelman, Steve. What Price Incentives?: Economists and the Environment (1981). Boston, Mass.: Auburn House, 1981.

13. Kneese, Allen V. and Charles L. Schultze. Pollution, Prices, and Public Policy (1975). Washington, DC: The Brookings Institute, 1975.

14. Lis, James and Kenneth Chilton. "Limits of Pollution Prevention." (1993) Society, volume 30, number 3, page 49 (7), March-April, 1993.

15. Marshall, Alfred. Principles of Economics, 8th ed. London: Macmillan, 1920.

16. Mill, John Stuart. Principles of Political Economy, ed. W. J. Ashley (1965). New York: Augustus M. Kelly, 1965.

17. Mills, Edwin S. and Philip E. Graves. The Economics of Environmental Quality (1986). New York: W.W. Norton, 1986.

18. OMB, Office of Management and Budget. Economic Analysis of Federal Regulations Under Executive Order 12866 (1995). Executive Office of the President, Office of Management and Budget, January 1995, p.8.

19. Parkin, Michael. Economics (1990). Addison-Wesley Publishing Company, Inc., 1990.

20. Pigou, A. C. Wealth and Welfare (1912). London: Macmillan, 1912.

21. Samuelson, Paul A. And William D. Nordhaus. Economics (1985). McGraw Hill, Inc., 1985.

22. Santos, Susan L., Vincent T. Covello, and David B. McCallum. "Industry Response to SARA Title III: Pollution Prevention, Risk Reduction, and Risk Communication." (1996) Risk Analysis, volume 16, number 1, 1996.

23. Schultze, Charles L. The Public Use of Private Interest (1977). Washington, DC: The Brookings Institute, 1977.

24. U.S. EPA (1995). 1993 Toxics Release Inventory: Public Data Release, EPA 745-R-95-010, March.

CHAPTER 2
DESCRIPTION OF REGULATORY OPTIONS

This chapter describes the regulatory options considered for this final rule. In Section 2.1, background information is presented on the development of the regulation. Section 2.2 discusses the changes to the reporting thresholds. Other changes to the section 313 reporting requirements for persistent bioaccumulative toxic (PBT) chemicals are identified in Section 2.3.

2.1 BACKGROUND

The final rule to modify EPCRA section 313 reporting requirements for PBT chemicals is limited to a relatively small number of chemicals. The chemicals initially reviewed were drawn from various lists of persistent and bioaccumulative chemicals including the Binational Level 1 list generated as part of the Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin. In addition, chemicals that received high scores for persistence and bioaccumulation from the Waste Minimization Prioritization Tool (WMPT) developed by EPA's Office of Solid Waste were also considered. Finally, the chemicals included in the dioxin and dioxin-like compounds category that EPA has marked for addition to the section 313 list were included in this initial review (62 FR 24887, May 7, 1997).[1]

Under Section 313(f)(1) of EPCRA, reporting thresholds are set at 25,000 pounds for chemicals that are manufactured or processed and 10,000 pounds for chemicals that are otherwise used. For certain chemicals, such as those that persist in the environment and bioaccumulate, the existing TRI thresholds may preclude the capture of important information because facilities manufacture, process or otherwise use the toxic chemicals at levels below the current TRI reporting thresholds. Under the final rule, EPA will revise reporting thresholds for TRI chemicals that are of concern because of their persistence and bioaccumulation characteristics. For those PBT chemicals not already currently listed, EPA is adding them to TRI, where appropriate. The lower reporting thresholds that EPA has considered are described in section 2.2.

In addition to revising the thresholds for these chemicals, the Agency is also making other concurrent changes in the program, such as eliminating the *de minimis* exemption for PBT chemicals. These changes are described in section 2.3.

[1] EPA intends to review additional chemicals in the future to determine if they should be considered persistent and bioaccumulative under section 313 and, if not already on the section 313 list, whether they should be added.

2.2 REVISED REPORTING THRESHOLDS

Under the current section 313 reporting requirements, important information on PBT chemicals is not captured due to the levels at which reporting thresholds are set. Under Section 313(f)(1) of EPCRA, reporting thresholds are currently set at 25,000 pounds for chemicals that are manufactured or processed, and 10,000 pounds for chemicals that are otherwise used.

EPA used a tiered approach in considering reporting thresholds for chemicals with varying potential for bioaccumulation and persistence. Toxic chemicals with very high persistence and bioaccumulation potentials, like those that have been widely recognized as PBT chemicals, are of greatest concern. A distinction was made between persistent bioaccumulative chemicals and *highly* persistent bioaccumulative chemicals by separating the PBT chemicals into two groups based on persistence and bioaccumulation potential:

- Highly Persistent Bioaccumulative Toxic Chemicals: section 313 chemicals that persist in the environment with a half-life of 6 months or greater and that have bioaccumulation factors or bioconcentration factor values of 5,000 or greater;

- Persistent Bioaccumulative Toxic Chemicals: section 313 chemicals that persist in the environment with a half-life between 2 and 6 months and that have bioaccumulation factors or bioconcentration factor values between 1,000 and 5,000.

The regulatory options that EPA evaluated were created by varying the reporting thresholds from their current levels of 25,000 pounds for manufacture and processing, and 10,000 pounds for otherwise use of EPCRA Section 313 chemicals. EPA considered lowering reporting thresholds for the PBT chemicals to either 1 pound, 10 pounds, 100 pounds, or 1,000 pounds manufactured, processed, and otherwise used, depending on the degree to which the PBT chemical persists and bioaccumulates. The reporting threshold for vanadium and vanadium compounds will remain at the current thresholds of 25,000 lbs manufactured or processed and 10,000 lbs otherwise used across all regulatory options.

Reporting thresholds considered for the dioxin and dioxin-like compounds category include 0.1 grams and 1 gram. The category of dioxin and dioxin-like compounds are highly persistent and bioaccumulative. However, these chemicals are generally produced in amounts much smaller than other section 313 chemicals. To capture any release data, a much lower reporting threshold than those set for other chemicals is required. In addition, EPA is changing the activity qualifier to the category to focus reporting on facilities that actually add to the environmental loading of dioxin. With this qualifier, manufacturing, processing, or otherwise using chemicals and chemical mixtures that contain these components as impurities created as a result of their manufacturing process would be subject to TRI reporting.

These chemical specific thresholds have been combined to form four regulatory options. The following options summarize the scope of EPA's analysis.

- **Option 1.** Reporting threshold of 1 pound manufactured, processed or otherwise used for the highly persistent bioaccumulative chemicals. Reporting threshold of 10 pounds manufactured, processed or otherwise used for the persistent bioaccumulative chemicals. Reporting threshold of 0.1 gram manufactured as a byproduct or manufactured, processed, or otherwise used as an impurity for the dioxin and dioxin-like compounds category. Reporting threshold of 25,000 lbs manufactured or processed and 10,000 lbs otherwise used for vanadium and vanadium compounds (except when contained in alloys).

- **Option 2.** Reporting threshold of 10 pounds manufactured, processed or otherwise used for the highly persistent bioaccumulative chemicals. Reporting threshold of 100 pounds manufactured, processed or otherwise used for the persistent bioaccumulative chemicals. Reporting threshold of 0.1 gram manufactured as a byproduct or manufactured, processed, or otherwise used as an impurity for the dioxin and dioxin-like compounds category. This is the selected option presented in the regulatory text. Reporting threshold of 25,000 lbs manufactured or processed and 10,000 lbs otherwise used for vanadium and vanadium compounds (except when contained in alloys).

- **Option 3.** Reporting threshold of 100 pounds manufactured, processed or otherwise used for the highly persistent bioaccumulative chemicals. Reporting threshold of 1,000 pounds manufactured, processed or otherwise used for the persistent bioaccumulative chemicals. Reporting threshold of 0.1 gram manufactured as a byproduct or manufactured, processed, or otherwise used as an impurity for the dioxin and dioxin-like compounds category. Reporting threshold of 25,000 lbs manufactured or processed and 10,000 lbs otherwise used for vanadium and vanadium compounds (except when contained in alloys).

- **Option 4.** Reporting threshold of 1,000 pounds manufactured, processed or otherwise used for both the highly persistent bioaccumulative chemicals and the persistent bioaccumulative chemicals. Reporting threshold of 1.0 gram manufactured as a byproduct or manufactured, processed, or otherwise used as an impurity for the dioxin and dioxin-like compounds category. Reporting threshold of 25,000 lbs manufactured or processed and 10,000 lbs otherwise used for vanadium and vanadium compounds (except when contained in alloys).

The thresholds for specific chemicals or chemical categories under the four regulatory options are presented in Table 2-1.

TABLE 2-1
PBT THRESHOLD REGULATORY OPTIONS

Chemical	Option 1	Option 2 (Selected Option)	Option 3	Option 4
Highly Persistent Bioaccumulative Toxic Chemicals				
Benzo(g,h,i)perylene	1 lb	10 lbs	100 lbs	1,000 lbs
Chlordane	1 lb	10 lbs	100 lbs	1,000 lbs
Heptachlor	1 lb	10 lbs	100 lbs	1,000 lbs
Hexachlorobenzene	1 lb	10 lbs	100 lbs	1,000 lbs
Isodrin	1 lb	10 lbs	100 lbs	1,000 lbs
Mercury; Mercury Compounds Category	1 lb	10 lbs	100 lbs	1,000 lbs
Octachlorostyrene	1 lb	10 lbs	100 lbs	1,000 lbs
Pentachlorobenzene	1 lb	10 lbs	100 lbs	1,000 lbs
Polychlorinated Biphenyls (PCBs)	1 lb	10 lbs	100 lbs	1,000 lbs
Toxaphene	1 lb	10 lbs	100 lbs	1,000 lbs
Vanadium; Vanadium Compounds Category	10,000/ 25,000 lbs*	10,000/ 25,000 lbs*	10,000/ 25,000 lbs*	10,000/ 25,000 lbs*
Persistent Bioaccumulative Toxic Chemicals				
Aldrin	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Methoxychlor	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Pendimethalin	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Polycyclic Aromatic Compounds Category	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Tetrabromobisphenol A	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Trifluralin	10 lbs	100 lbs	1,000 lbs	1,000 lbs
Dioxin and Dioxin-Like Compounds Category				
Dioxin and Dioxin-Like Compounds Category	0.1 gram	0.1 gram	0.1 gram	1 gram
* Under this final rule, vanadium will be reported on at the current thresholds of 10,000 lbs otherwise used and 25,000 lbs manufactured or processed.				

2.3 OTHER CHANGES

2.3.1 ADDITION OF CHEMICALS

EPA is adding seven chemicals and two categories of chemicals that persist and bioaccumulate in the environment to reporting under section 313:

- Benzo(g,h,i)perylene (CAS No. 191-24-2)
- Benzo(j,k)fluorene (Fluoranthene) (CAS No. 206-44-0)
- 3-Methylcholanthrene (CAS No. 56-49-5)
- Octachlorostyrene (CAS No. 29082-74-4)
- Pentachlorobenzene (CAS No. 608-93-5)
- Tetrabromobisphenol A (CAS No. 79-94-7)

- Vanadium (CAS No. 7440-62-2)[2]
- Vanadium Compounds
- Dioxins and Dioxin-like Compounds

A hazard assessment was conducted for these chemicals to determine if they meet the EPCRA section 313(d)(2) criteria for listing. Although identification of these chemicals has been based on their status as persistent bioaccumulative toxic chemicals, their addition is based solely on the determination that they meet the EPCRA section 313(d)(2)(B) or (C) listing criteria.

The cost of listing these chemicals is addressed in the analysis of the regulatory options, as presented in Chapter 3. Each of the regulatory options includes reporting thresholds that are lower than current reporting thresholds. All of the reporting resulting from the listing of these chemicals, including the additional reporting resulting from even lower reporting thresholds, is included in the estimates of reports and reporting facilities for each regulatory option.

2.3.2 ELIMINATION OF *DE MINIMIS* EXEMPTION FOR PBT CHEMICALS

EPA is eliminating the *de minimis* exemption for the PBT chemicals for which EPA is setting lower reporting thresholds.[3] The current reporting requirements under EPCRA section 313 allow a limited *de minimis* exemption for listed toxic chemicals in mixtures. The *de minimis* exemption allows facilities to disregard certain concentrations of chemicals in mixtures or other trade name products they import, process, or otherwise use in making threshold determinations for section 313 reporting. This exemption only applies to the manufacture of a toxic chemical if it is manufactured as an impurity or is imported. Currently, it is possible to meet an activity threshold for a toxic chemical on a facility-wide basis, but not be required submit a report under section 313 because the facility only deals with mixtures or trade name products containing the toxic chemical at levels below *de minimis*.

The *de minimis* exemption was not intended to be a small quantity exemption, but as an exemption based on the limited information likely to be readily available to facilities affected by EPCRA section 313. Allowing facilities to continue to take the *de minimis* exemption for PBT chemicals may deprive communities of important information on PBT chemicals. Some facilities may exceed the lower reporting threshold based on processes that involve the PBT chemical in a mixture where the PBT chemical is below the applicable *de minimis* level. All releases and other waste management activities associated with these activities would then be exempt from reporting. While these chemicals may exist in mixtures at below the *de minimis* levels they still concentrate in the environment and in organisms.

---

[2] Vanadium is currently listed under section 313 with the qualifier (fume or dust). EPA is removing the fume or dust qualifier for vanadium.

[3] Since vanadium will be listed at the current reporting thresholds, the *de minimis* exemption will still apply.

Examples in which lowering the reporting thresholds for PBT chemicals without eliminating the *de minimis* exemption might limit reporting include the following:

- Processing of metals and metal compounds found as trace contaminants in ores, coal and petroleum products;
- Otherwise use of metals and PCBs found as trace contaminants in fuels;
- Manufacture, processing, or otherwise use of hexachlorobenzene as an impurity in certain pesticides and chlorinated organic chemicals; and
- Manufacture, processing, or otherwise use of pentachlorobenzene as an impurity in certain pesticides and chlorinated organic chemicals.

The incremental costs of this specific action are expected to be limited because many of the chemicals identified as persistent and bioaccumulative in this action are manufactured as byproducts. The *de minimis* exemption does not currently apply to the manufacture of chemicals as byproducts. Thus, eliminating it will have no net effect on the reporting of those chemicals. In addition, EPCRA does not require additional monitoring or sampling in order to comply with the reporting requirements under EPCRA section 313. Information used should be based on production records, monitoring, or analytical data, guidance documents provided by EPA and trade associations and reasonable judgement on the part of the facility's management. Even with the elimination of the *de minimis* exemption for PBT chemicals, no further monitoring or analysis of production, process, or use is required.

The incremental costs of this specific action have not been estimated separately from the regulatory options. The expected effects of this action on reporting of individual PBT chemicals have been incorporated into the estimates of additional reporting as presented in appendices A-K. The estimated industry cost for each regulatory option, as presented in Chapter 3, incorporates the elimination of the *de minimis* exemption for PBT chemicals subject to lower reporting thresholds.

2.3.3 ALTERNATE THRESHOLD AND FORM A

EPA is requiring facilities to file Form R reports for the PBT chemicals with lower reporting thresholds. Current reporting rules allow facilities that have less than 500 pounds of production-related waste of a listed toxic chemical and that do not manufacture, process, or otherwise use more than one million pounds of that listed toxic chemical to file a Form A certification statement. The Form A certifies that the facility does not exceed either of these quantities for the toxic chemical, and includes facility and chemical identification information.

EPA is excluding all PBT chemicals from the alternate threshold of one million pounds. While the Form A does provide some general information on the quantities of the chemical as waste that the facility manages, the release, transfer, and waste management information is much more limited than that provided by the Form R.

The costs of this action are reflected in the "Per Report Cost" section of the cost analysis described in Chapter 3. All of the additional reports filed under the regulatory options that were analyzed are assigned the unit cost for filing the Form R.

2.3.4 RANGE REPORTING

EPA is requiring facilities filing reports on PBT chemicals to report numerical values for releases and off-site transfers for waste management. EPA currently allows facilities to report the amount either as a whole number or by using range codes for releases and off-site transfers for further waste management of the toxic chemical of less than 1,000 pounds. The reporting ranges are: 1 - 10 pounds; 11 - 499 pounds; and 500 - 999 pounds. For larger releases and off-site transfers for further waste management of the toxic chemical, the facility may report only the whole number.

While EPA provided range reporting primarily as a burden reducing measure for small businesses, the Agency noted a number of drawbacks. Use of ranges could misrepresent data accuracy because the low or the high end range numbers may not be close to the estimated value, even taking into account its inherent error *(i.e.*, errors in measurements and developing estimates). The user of the data must make a determination on whether to use the low end of the range, the mid-point, or the upper end. For example, a release of 501 pounds could be misinterpreted as 999 pounds if reported as a range of 500 to 999. This represents a 100 percent error. This uncertainty severely limits the applicability of release information where the majority of releases, particularly for PBT chemicals, are expected to be within the amounts eligible for range reporting.

The elimination of range reporting for PBT chemicals is not expected to affect the unit cost of reporting. Range reporting is related to how information is *presented* on the reporting form rather than how it is *calculated*. For example, a facility would calculate its estimate of chemical releases or other waste management based on readily available information. Under current reporting rules, the facility then has the option of presenting the result (if less than 1,000 pounds) as a point estimate or as a range in sections 5 and 6 of the Form R. There is no range reporting option for the presentation of data in section 8. As an issue of presentation, the elimination of range reporting for PBT chemicals is not expected to have any effect on unit reporting costs.

2.3.5 HALF-POUND RULE AND WHOLE NUMBER REPORTING

For PBT chemicals, EPA is requiring that all releases or other waste management quantities of greater than a tenth of a pound be reported, provided that the appropriate activity threshold has been exceeded and provided that the accuracy and underlying data support this level of precision. EPA is also requiring that for release and other waste management quantities less than ten pounds, fractional quantities (*e.g.*, 6.2 pounds) rather than whole numbers are to be reported. For the category of dioxin and dioxin-like compounds, EPA is requiring that facilities report all releases and other waste management quantities greater than 100 µg. EPA currently requires that facilities report numerical quantities as whole numbers. EPA also currently allows facilities to round releases of 0.5 pounds or less to zero.

For PBT chemicals, if the facility's release or other waste management estimates support reporting an amount that is more precise than whole numbers and two significant digits, then the facility should report that more precise amount. If the data and/or estimation techniques do not support this degree of accuracy, then the facility's estimates are not required to be reported to a greater degree of accuracy than is available.

EPA currently requires that facilities report numerical quantities in sections 5, 6, and 8 of Form R as whole numbers and does not require more than two significant digits. EPA also currently allows facilities to round releases of 0.5 pounds or less to zero. The combination of requiring the reporting of whole numbers and allowing rounding to zero may result in a significant number of facilities reporting their releases of some PBT chemicals, notably dioxins, as zero.

As an issue of presentation rather than estimation, this action for PBT chemicals is not expected to have any effect on unit reporting costs.

2.3.6 REPORTING LIMITATION FOR VANADIUM IN ALLOYS

EPA is limiting the reporting for vanadium to exclude alloys that contain the metal from reporting thresholds. Vanadium can be found in various types of alloys used at facilities which are subject to reporting under section 313.

For vanadium, EPA is including the qualifier "except when contained in an alloy" in the new listing for vanadium. Including this qualifier will effectively exclude vanadium from reporting when contained in an alloy.

Under this limitation for alloys, reporting facilities that use vanadium to make alloys must still report for vanadium since it is being used to manufacture an alloy. However, once incorporated into the alloy, vanadium is not reportable. In addition, for purposes of section 313 reporting, EPA considers metal compounds that are used to make alloys to exist as the parent metal in the alloys. Thus, the limitation on alloys reporting for vanadium applies to vanadium compounds once they are incorporated into an alloy. Cutting, grinding, shaving, and other activities involving an alloy do not negate the reporting limitations for alloys containing vanadium.

The effects of this action have been incorporated into the estimates of additional reports and reporting facilities described in Appendix K for vanadium and vanadium compounds.

2.3.7 ACTIVITY QUALIFIER FOR DIOXIN LISTING

EPA is changing the activity qualifier to the dioxin and dioxin-like compound category to focus reporting on facilities that actually add to the environmental loading of dioxin. The qualifier will read as follows: (Manufacturing; and the processing or otherwise use of dioxin and dioxin-like compounds if the dioxin and dioxin-like compounds are present in a chemical and if they were created during the manufacturing of that chemical.) With this qualifier, manufacturing, processing, or otherwise using chemicals and chemical mixtures that contain these compounds as impurities created as a result of their manufacturing processes would be subject to TRI reporting.

The expected effects of this action have been incorporated into the estimates of additional reports and reporting facilities described in Appendix B for dioxin and dioxin-like compounds.

CHAPTER 3
ESTIMATES OF THE NUMBER OF ADDITIONAL REPORTS AND AFFECTED FACILITIES

This chapter presents estimates of the number of additional reports on PBT chemicals, as well as the number of affected facilities in each industry group that may file these reports under the final rule.[1] Numbers of facilities and reports are presented for each regulatory option. These estimates are used to calculate the costs to the regulated community and to EPA (see Chapter 4) and to evaluate the impacts on small entities (see Chapter 5). Section 3.1 presents the estimated number of reports. Section 3.2 presents the estimated number of affected facilities.

3.1 ESTIMATED NUMBER OF ADDITIONAL REPORTS

As mentioned in Chapter 2, reporting thresholds will be revised for PBT chemicals already subject to TRI reporting requirements. For those PBT chemicals not already currently listed, EPA is adding them to TRI, where appropriate. Current TRI reporting of the chemicals considered under this rule is presented in Table 3-1.

As detailed in Appendices A through K, the number of reports expected to be filed for each PBT chemical by each industry group was estimated for four lower reporting thresholds: 1 lb, 10 lbs, 100 lbs, and 1,000 lbs manufactured, processed, or otherwise used. For dioxin and dioxin-like compounds, the number of reports was estimated assuming lower reporting thresholds of 0.1 grams and 1.0 gram manufactured as a byproduct or manufactured, processed, or otherwise used as an impurity. The reporting threshold for vanadium and vanadium compounds will remain at the current thresholds of 25,000 lbs manufactured or processed and 10,000 lbs otherwise used across all regulatory options. In many cases, these estimates were generated as a range when the development of point estimates was not possible. These ranges present a best estimate and a maximum number of reports. For the purposes of the cost analysis, the best estimate of the number of reports is used.

[1] The term “affected facilities” is used in this report to denote facilities that meet the revised TRI reporting requirements and are expected to submit at least one Form R for a PBT chemical. Additional facilities in an SIC code may be required to perform compliance determination activities if their industry group is subject to TRI reporting. A Form R is completed for a single chemical. Facilities may submit more than one Form R if they manufacture, process, or otherwise use more than one listed TRI chemical (including the newly listed PBT chemicals). The number of facilities performing compliance activities, and their attendant costs, are estimated in Chapter 4.

TABLE 3-1
REPORTING OF PBT CHEMICALS TO TRI IN 1996

Chemical Name	Number of Form R's	Number of Form A's	Total On-Site Releases (lbs)	Transfers Off-Site to Disposal (lbs)	Total On- and Off-Site Releases (lbs)
Aldrin	0	0	0	0	0
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Chlordane	1	0	800	0	800
Dicofol	2	2	500	200	700
Dioxin and Dioxin-Like Compounds	NA	NA	NA	NA	NA
Heptachlor	1	0	200	0	200
Hexachlorobenzene	10	0	1,000	23,000	24,000
Isodrin	0	0	0	0	0
Mercury Compounds	13	0	3,000	22,000	25,000
Mercury	20	1	15,000	4,000	19,000
Methoxychlor	3	0	30	0	30
Octachlorostyrene	NA	NA	NA	NA	NA
Pendimethalin	5	1	3,000	0	3,000
Pentachlorobenze	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	5	1	9,000	51,000	60,000
Polycyclic Aromatic Compounds	136	11	665,000	1,248,000	1,913,000
Tetrabromobisphenol A	NA	NA	NA	NA	NA
Toxaphene	0	0	0	0	0
Trifluralin	18	3	16,000	52,000	67,000
Vanadium (Fume or Dust)	11	3	2,000	38,000	40,000

Source: EPA, 1998.

The best estimate of the number of additional reports for each PBT chemical is presented by option in Table 3-2. Numbers of reports expected to be filed by each industry group under each option are presented in Table 3-3. As described in Chapter 2, Option 1 corresponds with the lowest reporting thresholds, while Option 4 corresponds with the highest reporting thresholds. As shown in both tables, the number of expected reports decreases as the reporting thresholds increase. More detailed explanations of the data sources, methodologies, and calculations used to generate these estimates are provided in Appendices A through K.

TABLE 3-2
NUMBERS OF REPORTS EXPECTED FOR EACH PBT CHEMICAL

Chemical	Numbers of Reports			
	Option 1	Option 2 (Selected)	Option 3	Option 4
Benzo(g,h,i)perylene	4,487	909	21	0
Dioxins and Furans	1,475	1,475	1,475	826
Hexachlorobenzene	3,772	778	73	3
Mercury and Mercury Compounds	11,357	5,346	2,482	1,472
Octachlorostyrene	303	230	67	65
Pesticides	280	264	199	186
Pentachlorobenzene	3,314	707	36	11
Polychlorinated Biphenyl (PCBs)	3,634	2,310	1,301	187
Polycyclic Aromatic Compounds Category	13,337	7,166	3,217	3,217
Tetrabromobisphenol A	150	150	150	150
Vanadium and Vanadium Compounds	655	655	655	655
TOTAL	42,764	19,990	9,676	6,776

3.2 ESTIMATED NUMBER OF AFFECTED FACILITIES

For each of the PBT chemicals listed in Table 3-2, the number of facilities expected to file a report for each chemical was estimated. Facilities potentially affected by the rule are found in the following industry groups:

- Metal mining (SIC code 10)
- Coal mining (SIC code 12)
- Electric services (SIC code 4911)
- Electric and other services (SIC code 4931)
- Combination utilities (SIC code 4939)
- RCRA subtitle C hazardous waste facilities (SIC code 4953)
- Chemical and allied products-wholesale (SIC code 5169)
- Petroleum bulk stations & terminals (SIC code 5171)
- Solvent recyclers (SIC code 7389)
- Manufacturing (SIC codes 20 -39)

The methodology used to estimate the numbers of reports is presented for each PBT chemical in Appendices A through K. Each chemical-specific appendix presents an estimate of the number of facilities in an industry group that may report on that PBT chemical. Because numbers of reports and numbers of facilities were estimated separately for each PBT chemical, the unique number of facilities expected to file reports is less than the sum of facilities across chemicals. Using a hypothetical example, assume that 200 coal mines may be expected to report on mercury and mercury compounds. Assume that 100 coal mines may also be expected to report on vanadium and vanadium compounds. The total number of unique facilities filing one or more chemical reports to TRI due to the final rule, however, could be 200 facilities, 300 facilities, or some number in between depending on the degree of overlap between facilities reporting on the different chemicals.

To estimate the costs of the rule (see Chapter 4), it was necessary to estimate the *unique* number of facilities expected to report under each option. Methodologies were developed for estimating the unique number of facilities from each industry group. These methodolgies are described below.

Metal Mining (SIC Code 10)

As shown in Appendices A through K, metal mining facilities are expected to file a maximum of one PBT report per facility for mercury. As facilities are only required to file one report per PBT chemical, the unique number of facilities from this SIC code equals the number of reports filed for mercury.

Coal Mining (SIC Code 12)

Appendices A through K indicate that all potential reporters in SIC code 12 will file a report for one PBT chemical: mercury. Therefore, for this SIC code, the unique number of facilities expected to report under all options is known to be 321, and the number of reports filed per facility is one.

Electric Services (SIC Code 4911)

For SIC code 4911, data on fuel throughput and chemical concentration by fuel type were used to estimate the unique number of coal- and oil-burning facilities expected to report. For each facility, the chemical concentration in a given fuel was multiplied by the throughput of that fuel to calculate the amount of each PBT chemical manufactured or otherwise used. By comparing this amount to the relevant threshold, it was possible to estimate the unique number of facilities reporting at each option, as well as the number of reports each facility would submit.

Electric and Other Services (SIC Code 4931) and Combination Utilities (SIC Code 4939)

For SIC codes 4931 and 4939, information on expected reporting in SIC code 4911 was used. To estimate the total number of facilities reporting on each PBT chemical in SIC codes 4931 and 4939, the percentage of facilities in SIC code 4911 exceeding each threshold was

applied to the number of facilities in SIC codes 4931 and 4939. This calculation was made separately for coal- and oil-burning facilities.

A distribution of reports per facility was developed by ordering chemicals according to their concentration in both fuel types (coal and residual oil). Because reporting is directly related to fuel throughput, the number of reports associated with each chemical increases as chemical concentrations increase. By examining the change in the expected number of reports between chemicals, it was possible to estimate the number of facilities filing each possible number of reports per facility.

Using a hypothetical example, assume that facilities in SIC code 4931 are expected to report on a maximum of three PBT chemicals. Assume 50 facilities file reports for mercury, 60 facilities file reports for PACs and 100 facilities file reports for vanadium. As the number of reports is based on throughput and concentration data, the chemical with the lowest number of reports has the lowest concentration. If a facility files a report for the chemical with the lowest concentration, it will also file reports for every chemical with a higher concentration. As such, 50 facilities would file three reports each, 10 facilities (60 - 50) would file two reports each, and 40 facilities (100 - 60) would file one report each.

The distribution of reports per facility, developed as described above, was applied to the best estimate of total reports for each SIC code. The number of unique facilities expected to report was estimated by dividing the number of reports by the number of reports per facility and summing across the distribution.

Petroleum Bulk Stations & Terminals (SIC Code 5171)

The estimated number of facilities in SIC Code 5171 reporting to TRI is based on the methodology presented in Appendix H of the industry expansion EA. This methodology was enhanced to consider the extent to which facilities handle more than one product type containing the same TRI chemical. Data on fuel throughput and chemical concentration by fuel type were used to estimate the unique number of facilities that will file reports for each TRI chemical. The estimate was based on a set of six model facilities described in the industry expansion EA, each characterized by its throughput of petroleum products containing at least one TRI constituent above *de minimis* levels. Each model facility is assumed to represent a number of facilities with similar fuel throughput characteristics, a given subset of which are assumed to handle each of the petroleum products. The percentage of facilities handling each petroleum product was calculated using data from the Independent Liquid Terminals Association (ILTA) directory, which identifies the different combination of products handled by each member facility.

The following methodology was used to estimate the number of affected facilities represented by each of the six model facilities:

- Using available concentration data, calculate the minimum annual throughput required to exceed current reporting thresholds for each TRI constituent of each petroleum product;

- Identify the petroleum products for which annual throughput is sufficient to exceed current reporting thresholds for at least one TRI constituent;
- Identify the total number of TRI reportable constituents associated with the petroleum products identified in the previous step;
- Identify each facility in the ILTA directory that handles at least one of the petroleum products expected to result in reporting;
- Estimate the unique number of reports filed by each facility in the ILTA directory, taking care not to double-count chemicals present in more than one product;
- Develop a distribution of facilities across the full range of reports per facility; and
- Apply the distribution developed for a given model facility to number of facilities represented by that model facility to estimate the number of affected facilities submitting each unique number of reports per facility.

Summing the number of facilities submitting at least one report across all six model facilities yields the total number of affected facilities in SIC code 5171.

Manufacturing (SIC Codes 20-39); RCRA Subtitle C Hazardous Waste Facilities (SIC Code 4953); Chemical and Allied Products-Wholesale (SIC Code 5169); and Solvent Recyclers (SIC Code 7389)

For all other industry groups, the unique number of facilities was estimated through a multi-step process. First, it is assumed that the distribution of PBT reports per facility will be similar to the distribution of reports per facility for all other TRI chemicals. Second, for each industry group, a distribution of reports per facility was predicted, based on data for facilities currently reporting to TRI. Third, a distribution of total reports was developed for each industry group from the distribution of reports per facility and the best estimate of total reports. Finally, the number of reports was divided by the number of reports per facility to estimate the number of unique facilities.

The 1996 TRI data (the most recent year for which TRI data were available at the time of analysis) were analyzed to determine the distribution of facilities by the number of reports filed per facility. There were 21,626 facilities that submitted 71,281 reports to TRI in 1996. Of these, 8,272 filed a single report, 4,302 facilities filed two reports, 3,153 facilities filed three reports, and so on. This distribution of *facilities* was used to develop a parallel distribution of *reports*.

Thus, 8,272 reports (8,272 facilities x 1 report per facility), or 11.6% of all reports (8,272 / 71,381), were filed by facilities filing one report per facility; 8,604 reports (4,302 facilities x 2 reports per facility), or 12.1% of all reports (8,604 / 71,381), were filed by facilities filing two reports per facility; etc. This distribution of reports consisted of 54 observations, one observation for each different number of reports per facility.

The TRI distribution of reports per facility was divided into segments according to the maximum number of PBT chemicals associated with each industry group. For example, Appendices A through K predict that 96 reports will be filed by facilities in SIC code 7389 (solvent recovery services) under Option 2, and that these facilities will file a maximum of three

reports per facility. The TRI distribution of reports was divided into three equal segments, each representing one, two, or three reports per facility. Within each segment, the percentages of reports per facility are summed to create a new fitted distribution. In this example, the first 18 observations (54 / 3 = 18) are summed to represent the percent of reports filed by solvent recovery services filing one report. This percentage equals 88%. The sum of the second 18 observations, or 10%, represent the percent of reports filed by solvent recovery services filing two reports. The sum of the third 18 observations, or 2%, represent the percent of reports filed by solvent recovery services filing three reports.

This fitted distribution of reports per facility was applied to the best estimate of total reports for each SIC code. The number of unique facilities expected to report was estimated by dividing the number of reports by the number of reports per facility and summing across the distribution. For industry groups where the application of the fitted distribution yielded an estimated number of unique facilities that exceeds the maximum number of potential reporters, the number of unique facilities was capped at the maximum.

Calculation of rule familiarization costs also requires the estimation of the number of unique facilities that will be reporting to TRI for the first time, since only first time reporters will incur this cost (see Chapter 4). Due to the recent TRI industry expansion, all of the facilities in the non-manufacturing industry groups expected to report under this final rule for PBT chemicals will already be filing for other chemicals. Therefore, first time filers are limited to the manufacturing sector (SIC Codes 20 -39). To generate an estimate of first time filers it is assumed that the distribution of reports per facility will not change after the PBT rule is promulgated. It is further assumed that if a facility files a single report, and it is for a PBT chemical, then the facility must be new to the TRI system. Therefore, the unique number of facilities submitting reports for PBT chemicals, calculated as described above, is multiplied by the percentage of reporters that filed only one report in 1996. Table 3-3 presents the number of unique facilities, first time filers and number of reports by industry group and by option.

TABLE 3-3
NUMBERS OF UNIQUE FACILITIES AND REPORTS BY INDUSTRY GROUP

	Option 1			Option 2 (Selected Option)			Option 3			Option 4		
Industry Group	**Number of Unique Facilities**	**Number of First Time Filers**	**Number of Reports**	**Number of Unique Facilities**	**Number of First Time Filers**	**Number of Reports**	**Number of Unique Facilities**	**Number of First Time Filers**	**Number of Reports**	**Number of Unique Facilities**	**Number of First Time Filers**	**Number of Reports**
SIC 10	131	0	131	81	0	81	46	0	46	6	0	6
SIC 12	321	0	321	321	0	321	321	0	321	321	0	321
SIC 4911	512	0	2,630	490	0	2,074	466	0	1,490	405	0	1,103
SIC 4931	292	0	1,417	265	0	1,118	234	0	812	194	0	597
SIC 4939	33	0	149	29	0	116	24	0	85	22	0	62
SIC 4953	140	0	215	132	0	202	131	0	185	81	0	107
SIC 5169	18	0	20	14	0	14	14	0	14	14	0	14
SIC 5171	2,323	0	6,556	1,705	0	3,489	834	0	1,683	823	0	980
SIC 7389	89	0	98	89	0	96	0	0	0	0	0	0
SIC 20-39	20,347	7,793	31,227	8,131	3,114	12,479	3,284	1,258	5,040	2,334	894	3,582
TOTAL	24,206	7,793	42,764	11,257	3,114	19,990	5,354	1,258	9,676	4,200	894	6,772

LITERATURE CITED

1. U.S. EPA. 1998. 1996 Toxics Release Inventory: Public Data Release — Ten years of Right-to-Know. Office of Pollution Prevention and Toxic Substances. EPA 745-R-98-005. May.

CHAPTER 4
COST ESTIMATES

This chapter estimates the costs that industry and EPA may incur as a result of the final rule to modify TRI reporting requirements for certain persistent bioaccumulative toxic (PBT) chemicals. Section 4.1 describes the methodology used to estimate the total industry costs. Section 4.2 details the estimated costs to EPA of implementing the expanded program. Section 4.3 summarizes the total costs.

4.1 INDUSTRY COST ESTIMATES

In this section, the costs that may be incurred by industry as a result of the final rule are estimated. These costs are presented for the selected option as well as for three additional regulatory options. Section 4.1.1 describes the methodology used to estimate total industry costs for each option. Section 4.1.2 discusses the unit cost estimates for each of the activities that a facility may need to perform to comply with the section 313 reporting requirements. Section 4.1.3 presents the total cost estimate of each option for industry. Section 4.1.4 discusses the costs incurred by publicly-owned electric utilities. Finally, Section 4.1.5 describes the transfer payments and non-monetized costs associated with this rulemaking.

4.1.1 METHODOLOGY

Total industry costs were calculated using the following four-step procedure:

Step 1: Identify and describe the tasks that potentially affected facilities will have to perform to comply with the section 313 requirements.

Step 2: For each task, estimate the hours of managerial, technical, and clerical labor needed to complete it. Based on typical labor rates, calculate the unit cost of each task for the first year of compliance, when some learning must take place, and subsequent years, when less time is needed because facilities are more familiar with the tasks.

Step 3: Estimate the number of unique facilities that will perform each task. Estimate the number of facilities that will perform some portion of the required tasks in order to determine that they do not have to comply with the reporting requirements. Estimate the number of reports to be filed in each industry group.

Step 4: For each task, multiply the unit cost by the number of unique facilities and/or reports, and then sum the results to compute the total industry costs for the first year and subsequent years.

The tasks associated with TRI reporting under the final rule include:

- **Compliance Determination:** Facilities must determine whether they meet the criteria for reporting on the PBT chemicals at the lower thresholds. This task includes the time required to review the list of PBT chemicals, to become familiar with the definitions, exemptions, and new threshold requirements under the TRI program, and to conduct preliminary threshold calculations to determine if the facility is required to report.
- **Rule Familiarization:** Facilities that are reporting under section 313 for the first time due to the final rule must read the reporting package and become familiar with the reporting requirements.
- **Report Completion:** Facilities must gather data and perform calculations to provide the information required on the form.
- **Mailing and Recordkeeping:** Facilities must maintain recordkeeping systems and mail the report to EPA and the State.
- **Supplier Notification:** Facilities supplying mixtures and trade name products containing newly listed PBT chemicals above *de minimis* levels must notify their customers of the contents of their products on an annual basis.

The skills required to comply with the section 313 reporting requirements (including the requirements associated with section 6607 of the PPA) will vary from facility to facility depending upon factors such as the complexity of the facility's processes, the type of use and disposition of PBT chemicals at the facility, and transfers from the facility. Those responsible for reporting may often have engineering, scientific, or technical backgrounds. Compliance does not, however, necessarily require an engineering or other similar degree. At a minimum, an understanding of the facility's chemical purchases and production processes is required. Necessary skills may include the ability to evaluate and interpret records, understand material safety data sheets, and determine throughput or production volumes. Depending on the facility, estimates may be calculated using existing data collected under federal, state, or local regulations; emissions factors; design data supplied by the equipment manufacturer; mass balance techniques; or engineering calculations. Each technique requires varying skills and levels of sophistication to complete. In some instances, EPA guidance documents may supplant the need for a particular skill.

The next section discusses how the unit cost associated with each of these specific tasks was estimated.

4.1.2 UNIT COST ESTIMATES

This section explains how the cost estimates, or unit costs, were developed for each task that facilities might have to perform under the final rule. Depending on whether the unit cost is report- or facility-specific, total costs for a task can be calculated by multiplying the unit cost by the number of reports for which the task must be performed or by the number of facilities performing it. The estimated number of unique facilities and chemical reports expected under each regulatory option is presented in Table 4-1. The estimated unit cost for each of the tasks is presented in Table 4-2.

Each cost estimate is made up of two components: the unit time estimates (i.e., number of labor hours required of each type of personnel to complete a task); and the hourly wage rates for each level of personnel. The unit time estimates are taken from the Regulatory Impact Analysis (RIA) for the addition of certain industry groups to EPCRA section 313 and from the Regulatory Impact Analysis (RIA) for the addition of chemicals to the EPCRA section 313 list of toxic chemicals (USEPA, 1997; USEPA, 1994). These RIAs relied on two additional sources to estimate the labor hours required to perform each task:

- The Regulatory Impact Analysis (RIA) for the original section 313 rulemaking (US EPA, 1988).
- An Information Collection Request (ICR) update for section 313 reporting (USEPA, 1993).[1] The ICR update accounts for changes to the reporting requirements since the RIA for the original rule (such as the addition of the source reduction and recycling activities by the Pollution Prevention Act of 1990), and incorporates data on facilities' actual experience with section 313 reporting.

Hourly wage rates are divided into three categories: managerial, technical, and clerical. Updated 1998 hourly labor rates, including fringe benefits and overhead, were developed by EPA for each of these categories using the methodology developed for EPA's Comprehensive Assessment Information Rule (CAIR) (Karnes, 1987). The new wage rates were calculated using current data on salaries and benefits for these three labor categories.

Wage data used in developing the basic wage rates for this analysis were derived from 1996 wage information published by the Bureau of Labor Statistics (BLS) for all goods-producing, private industries (USDL, 1998). The managerial, technical, and clerical wage rates are based on wage information for four BLS occupation categories: engineers, accountants, attorneys, and secretaries. As presented in Table 4-3, the managerial and technical level wage rates are composites of the BLS wage rates for several occupation categories and levels. The managerial level wage rate is a composite of the wage rates of Engineers (levels VI-VIII),

[1]To comply with the Paperwork Reduction Act, federal agencies must renew ICRs periodically. An ICR renewal for TRI (ICR #1363.05) was submitted to OMB in September 1992.

TABLE 4-1
ESTIMATED NUMBER OF UNIQUE FACILITIES AND CHEMICAL REPORTS UNDER THE FINAL RULE

SIC Code	Option 1		Option 2 (Selected Option)		Option 3		Option 4	
	Unique Facilities Reporting	Number of Reports	Unique Facilities Reporting	Number of Reports	Unique Facilities Reporting	Number of Reports	Unique Facilities Reporting	Number of Reports
10 — Metal Mining (except 1011, 1081, 1094)	131	131	81	81	46	46	6	6
12 — Coal Mining (except 1241)	321	321	321	321	321	321	321	321
4911/4931/4939 — Electric Services (Coal and Oil Facilities Only)	837	4,196	784	3,308	724	2,387	621	1,762
4953 — RCRA Subtitle C TSDFs Only	140	215	132	202	131	185	81	107
5169 — Chemical Wholesalers	18	20	14	14	14	14	14	14
5171 — Bulk Petroleum	2,323	6,556	1,705	3,489	834	1,683	823	980
7389 — Solvent Recovery Only	89	98	89	96	0	0	0	0
20-39 — Manufacturing Facilities	20,347	31,227	8,131	12,479	3,284	5,040	2,334	3,582
TOTAL	**24,206**	**42,764**	**11,257**	**19,990**	**5,354**	**9,676**	**4,200**	**6,772**

TABLE 4-2
UNIT TIME AND COST ESTIMATES FOR ACTIVITIES PERFORMED BY INDUSTRY

Activity	Unit Time Estimates (Hours) (per report or per facility)			Unit Cost[a] (1998 Dollars)
	Managerial	Technical	Clerical	
First Year				
Rule Familiarization[b]	12.0	22.5	0.0	$2,489
Compliance Determination[b]	4.0	12.0	0.0	$1,119
Form R Completion[c]	20.9	45.2	2.9	$4,796
Recordkeeping/Mailing[c]	0.0	4.0	1.0	$283
Supplier Notification[b]	0.0	7.0	17.0	$886
Subsequent Years				
Compliance Determination[b]	1.0	3.0	0.0	$280
Form R Completion[c]	14.3	30.8	2.0	$3,274
Recordkeeping/Mailing[c]	0.0	4.0	1.0	$283
Supplier Notification[b]	0.0	7.0	17.0	$886

[a] Based on loaded hourly wage rates of $86.86, $64.30, and $25.63 for managerial, technical, and clerical labor, respectively.

[b] The unit cost for this activity is estimated at the facility level. It is treated as a fixed cost that does not vary with the number of chemicals handled or reported by a facility.

[c] The unit cost for this activity is estimated to vary with the number of reports submitted. The total cost for this activity at a facility is calculated by multiplying the unit cost by the number of reports submitted by that facility.

Sources: U.S.EPA (1997). *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313 Reporting*. April.
U.S. EPA (1994). *Regulatory Impact Analysis of the Final Rule to Add Various Chemicals and Chemical Categories to the EPCRA Section 313 List of Toxic Chemicals.* November 18.

TABLE 4-3
LOADED HOURLY WAGE RATES BY LABOR CATEGORY

Labor Category	Occupation (levels)	June 1996 Average Salary	Weighting Factor	1996 Composite Salary	ECI Ratio 6/96:3/98	1998 Adjusted Salary	1997 Benefits (% Salary)	Overhead (%Salary)	1998 Loaded Annual Salary	1998 Loaded Hourly Rate
	Engineer (VI-VIII)	$104,971	10/17	$61,748						
	Attorney (IV-VI)	$116,255	5/17	$34,193						
	Accountant (V-VI)	$82,030	2/17	$9,651						
Managerial	Composite			$105,592	1.087	$114,779	40.4%	17.0%	$180,662	$86.86
	Engineer (III-VIII)	$83,243	5/6	$69,369						
	Accountant (III-VI)	$65,780	1/6	$10,963						
Technical	Composite			$80,332	1.055	$84,750	40.8%	17.0%	$133,736	$64.30
Clerical	Secretarial (I-V)	$31,502	1/1	$31,502						
	Composite			$31,502	1.063	$33,487	42.2%	17.0%	$53,311	$25.63

[a] Composite Salaries are determined by multiplying average salaries by the weighting factor and summing across occupations.

Sources: U.S. Department of Labor, Bureau of Labor Statistics (1996). *Occupational Compensation Survey, National Summary, 1996.*
U.S. Department of Labor, Bureau of Labor Statistics (1997). *Employer Costs for Employee Compensation — March 1997.*
U.S. Department of Labor, Bureau of Labor Statistics (1997). USDL News Release: 97-371, October 21. Table 11.
U.S. Department of Labor, Bureau of Labor Statistics (1998). *Employment Cost Index — March 1998.*
U.S. Department of Labor, Bureau of Labor Statistics (1998). USDL Bulletin 2497, March 1998, Tables A-1, D-1, and D-3.
U.S. Department of Labor, Bureau of Labor Statistics (1998). USDL News Release: 98-170. April 30. Table 6.

Accountants (levels V-VI), and Attorneys (levels IV-VI).[2] The technical level wage is a composite of the wage rates of Engineers (levels III-VIII) and Accountants (levels (III-VI)[3]. The clerical wage rate is an average of all the clerical wage levels provided by BLS (i.e., levels I-V). The weighting factors used to develop the managerial and technical wage rates are based on information provided by the chemical industry and chemical industry trade associations on the typical fraction of total reporting effort that is accounted for by each specific BLS occupation category.[4]

The 1996 composite annual salary estimates were adjusted to first-quarter 1998 dollars using the Employment Cost Index (ECI) for white-collar occupations in private industries (US DL, 1998). The 1998 adjusted, composite salary for the managerial, technical, and clerical labor categories was then multiplied by benefits and overhead factors to estimate a 1998 loaded, annual salary. Detailed benefits data for white-collar occupations in private, goods-producing industries were used to account for the additional cost of benefits for managerial, technical, and clerical labor (USDL, 1998). The overhead factor of 17 percent is based on information provided by the chemical industry and chemical industry trade associations. The loaded annual salary was then divided by 2,080 hours (i.e., the average annual number of hours for a full-time employee) to derive the loaded, hourly wage rates used in this analysis for each labor category. The hourly wage rates are $86.86 for managerial personnel, $64.30 for technical personnel, and $25.63 for clerical personnel, all in 1998 dollars.

The remainder of this section discusses the costs associated with each specific industry task. Activities are organized into two categories: per facility costs and per report costs. As noted previously, these costs are summarized in Table 4-2.

Per Facility Costs

Compliance Determination

Under the final rule, a facility must report under section 313 if it: (a) is within SIC codes covered by the TRI program; (b) has 10 or more employees or the equivalent of 10 full-time employees; and (c) manufactures, processes, or uses any of the PBT chemicals above the

---

[2]Managerial labor is assumed to be composed of operational labor, including engineers or chemists at the plant manager, facility research manager, or higher levels, legal managers, and financial managers.

[3]Technical labor is assumed to be composed of operational labor, including senior engineers or chemists equivalent to head process or project engineer, and financial labor, such as accountants. It is assumed that operational labor is used at a five-to-one ratio with financial labor.

[4]The methodology used for the CAIR analysis also used wage information for chemists in estimating the managerial and technical wage rates. The current methodology does not include chemists in estimating the composite wage rates because updated information on wage levels for chemists was not available from BLS. The Engineer salary information is expected to be similar to Chemist salary information. In addition, BLS data for Level VI attorneys in goods-producing industries were not available, so wages for all private industry level VI attorneys were used instead.

threshold quantities established for each chemical. All facilities in TRI covered industry groups must determine if they meet these criteria. It is assumed that facilities will not incur any incremental costs to make determinations regarding the first two criteria. The third determination, however, would require the management and technical staff to determine the types of PBT chemicals used at the facility, and whether they are manufactured, processed, or otherwise used above threshold levels.

The estimated number of facilities performing a compliance determination in the first year and in subsequent years in each of the SIC codes and/or industry groups is presented in Table 4-4. For all industry groups, the number of facilities performing compliance determinations corresponds to the estimated number of facilities in each industry group with greater than or equal to 10 FTEs. The total number of facilities for each industry group was taken from information collected by the US Department of Commerce (USDOC, 1995) and from the RIA for the addition of certain industry groups to EPCRA section 313 (USEPA, 1997).

TABLE 4-4
NUMBER OF FACILITIES CONDUCTING COMPLIANCE DETERMINATIONS
FINAL RULE — ALL OPTIONS

SIC Code	First Year	Subsequent Years
10—Metal Mining (except 1011, 1081, 1094)	268	268
12—Coal Mining (except 1241)	1,749	1,749
4911/4931/4939—Electric Services (Coal and Oil Facilities Only)	977	977
4953—RCRA Subtitle C TSDF's Only	162	162
5169—Chemical Wholesalers	2,801	2,801
5171—Bulk Petroleum	3,842	3,842
7389—Solvent Recovery Only	191	191
20-39—Manufacturing Facilities	180,507	180,507
TOTAL	190,497	190,497

To make the compliance determination, a facility must first review whether it manufactures, processes, or otherwise uses any of the PBT chemicals in any quantity. If it does, then it must make a threshold determination to ascertain whether it manufactures, processes, or uses more than a threshold amount of the chemical or chemicals it has identified depending on the chemical specific threshold. For the persistent and bioaccumulative chemicals the selected reporting threshold presented in the regulatory text is 100 pounds manufactured, processed, or otherwise used. For the highly persistent and bioaccumulative chemicals the selected reporting threshold presented in the regulatory text is 10 pounds manufactured, processed, or otherwise

used. For dioxin and dioxin-like compounds, the selected reporting threshold presented in the regulatory text is 0.1 grams manufactured. For tetraethyl lead (TEL) and tetramethyl lead (TML), reports would only be filed separately from lead compounds if more than 1 pound of TEL or TML is included in the threshold determinations for the lead compounds category. Taken together with other changes to the reporting requirements such as elimination of the *de minimis* exemption and alternate reporting threshold, these chemical specific reporting thresholds form the selected option.

The first compliance determination activity involves checking the list of PBT chemicals, therefore, the level of effort is related to the number of chemicals on the list. This step should be completed within a relatively short period of time. The second activity involves a more detailed set of calculations, and will typically involve a more substantial effort. Therefore, the time spent making threshold determinations is expected to comprise the majority of the time spent making a compliance determination.

In the Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313, it was estimated that compliance determination would require one hour of managerial time and three hours of technical time to complete the compliance determination in subsequent years (USEPA, 1997). The RIA for the original section 313 rule assumed that facilities would require four times as many labor hours to complete a compliance determination in the first year compared to subsequent years (USEPA, 1988). Applying this four-fold factor yields estimates of four hours of managerial time and twelve hours of technical time per facility to make the compliance determination in the first year.

In both first and subsequent years, it is unclear whether making a compliance determination for the PBT chemicals would be harder than, easier than, or equally as difficult as making the determination for the current list of over 600 chemical and chemical compounds. Compliance determination might be more complicated in situations where the PBT chemical is a byproduct or an impurity of a facility's main production processes, or is produced inadvertently outside a facility's main production processes. By contrast, for very low thresholds it may be easy for facilities to ascertain that they manufacture, process or use the chemical in at least some quantity. To generate an extremely precise burden estimate for compliance determination, the particular circumstances at each facility using PBT chemicals would have to be known. Such a detailed understanding of per facility chemical usage was not possible for this analysis. Therefore, it is assumed that the average time needed by a facility for compliance determination will be proportional to the number of reports submitted for the PBT chemicals in the first year and in all subsequent years. The estimated number of new reports under the selected option (Option 2) as well as the other three options is shown in Table 4-1. The ratio of new reports expected under the final rule to total reports before the final rule under current reporting requirements is used as a weighting factor to adjust the unit cost estimate for compliance determination. The adjusted unit cost estimates for each of the options in first and subsequent years is presented in Table 4-5.

TABLE 4-5
ADJUSTED UNIT COSTS FOR COMPLIANCE DETERMINATION BY OPTION

	Expected Number of PBT Reports	Total Number of Reports[5]	Weighting Factor	Adjusted Unit Cost for Compliance Determination
FIRST YEAR				
Option 1	42,764	117,889	0.36	$402.84
Option 2 (Selected)	19,990	117,889	0.17	$190.23
Option 3	9,676	117,889	0.08	$89.52
Option 4	6,772	117,889	0.06	$67.14
SUBSEQUENT YEAR				
Option 1	42,764	117,889	0.36	$100.80
Option 2 (Selected)	19,990	117,889	0.17	$47.60
Option 3	9,676	117,889	0.08	$22.40
Option 4	6,772	117,889	0.06	$16.79

To calculate the incremental cost of compliance determination for the PBT Rule by industry group, the adjusted unit compliance cost is multiplied by the number of facilities in the industry group with more than 10 FTEs.

Rule Familiarization

If a facility will be reporting under the section 313 requirements for the first time due to the final rule, facility staff must review and comprehend the reporting requirements. At a minimum, this effort will involve reading the instructions to the Toxic Chemical Release Inventory Reporting Form R, however, it may also involve consulting EPA guidance documents, attending a training course, and/or calling the EPCRA technical hotline. The cost associated with rule familiarization occurs only in the first year that a facility becomes subject to reporting. In subsequent years, staff are assumed to be familiar with the requirements that apply to their facility.

[5] In 1996, 71,735 reports were submitted to TRI. In addition, an estimated 46,154 reports will be submitted by industries affected by the TRI Industry Expansion Rule. As a result, the total number of reports is estimated to be 117,889.

Thus, the facility would no longer bear this cost. Similarly, facilities reporting on one or more PBT chemicals that already report on one or more existing TRI chemicals will not incur a rule familiarization cost.

It is estimated that facilities reporting under section 313 for the first time will need to make a one-time expenditure of 34.5 hours for rule familiarization. This burden estimate is comprised of 12 hours of management time and 22.5 hours of technical time (USEPA, 1988). Due to the recent TRI industry expansion, all of the facilities expected to report in the non-manufacturing SIC Codes will already be reporting to TRI. Therefore, first time filers are limited to facilities in the manufacturing industry group (SIC Codes 20-39). To generate an estimate of first time filers it is assumed that the distribution of reports per facility will not change after the PBT rule is promulgated. It is further assumed that if a facility files a single report, and it is for a PBT chemical, then the facility must be new to the TRI system. Therefore, the unique number of facilities submitting reports for PBT chemicals, calculated as described above, is multiplied by the percentage of reporters that filed only one report in 1996 (38.3%). The cost of rule familiarization is then calculated by applying the unit cost as shown in Table 4-2 to the number of first time filers presented in Table 4-6.

TABLE 4-6
NUMBER OF UNIQUE FACILITIES AND FIRST TIME FILERS

	Unique Number of Manufacturing Facilities	Percent of Single Filers in 1996	Number of First Time Filers
FIRST YEAR			
Option 1	20,347	38.3	7,793
Option 2 (selected)	8,131	38.3	3,114
Option 3	3,284	38.3	1,258
Option 4	2,334	38.3	894

Supplier Notification

Under the current section 313 reporting requirements, suppliers of mixtures or trade name products containing listed chemicals above *de minimis* levels are required to notify their customers of the contents of their products on an annual basis. Supplier notification provides recipient facilities with information on the toxic chemical composition of the products they use and on the reporting requirements that may accompany the use of such chemicals. This information is then used in making threshold determinations and release calculations. The

notification can be provided as a letter that identifies the chemical by name and CAS number and indicates its percentage by weight in the formulation. The notification can also be provided on the Material Safety Data Sheet (MSDS) for the product.

Under the final rule, the supplier notification requirements are unchanged. Thus, the only facilities expected to incur additional supplier notification costs as a result of the rule are those in SIC codes 20-39 selling or otherwise distributing mixtures or trade name products containing the PBT chemicals that 1) are not currently listed under EPCRA Section 313, and 2) are present above *de minimis* concentrations in the mixture or trade name product. The PBT chemicals meeting this description include: tetrabromobisphenol A, vanadium compounds, and pentachlorobenzene. Based on information in the chemical specific appendices (Appendices B - K), the number of facilities supplying mixtures or trade name products possibly containing each of these chemicals was estimated and is listed in Table 4-7.

TABLE 4-7
NUMBER OF FACILITIES EXPECTED TO PROVIDE SUPPLIER NOTIFICATION UNDER THE FINAL RULE

Chemical	Number of Facilities Providing Supplier Notification
Tetrabromobisphenol A	59
Vanadium Compounds	14
Pentachlorobenzene	4
Total	77

The burden associated with performing supplier notification is estimated to be 24 hours per facility (USEPA, 1993). Of this, 7 hours are technical hours, and 17 hours are clerical hours. To estimate the total cost of supplier notification, the unit cost associated with supplier notification (presented in Table 4-2) is applied to the total number of facilities listed in Table 4-7 above. The cost associated with supplier notification will not vary across regulatory options since the requirement is not dependent on the reporting threshold.

Per Report Costs

Form R Completion

Given the persistent, bioaccumulative, and toxic nature of the PBT chemicals, facilities will not be able to take advantage of the alternate manufacture, process, or otherwise use threshold of one million pounds under the final rule. All facilities filing reports on PBT chemicals with lower reporting thresholds must use the Form R.

Facilities that determine they must report on a PBT chemical under the section 313 reporting requirements will incur costs to retrieve, process, review, and transcribe the information necessary to complete each report. Most of the time spent on form completion is used to calculate releases, transfers, and other waste management information; relatively little time is required to copy information to the form. The facility must complete one Form R for each PBT chemical on which it reports. This effort will require more time in the first year than in subsequent years. In subsequent years, facilities will need to verify and update data, review previous calculations, and modify the information reported on the previous year's Form R, rather than estimate or retrieve data for the first time.

The estimated time for report completion equals 47 hours (14.3 hours of managerial, 30.8 hours of technical, and 2 hours of clerical time) (USEPA, 1997). This estimate represents a "subsequent-year" cost, because facilities already have experience preparing the form.

In order to estimate the report completion time for the first year, the subsequent-year cost was multiplied by the ratio of first-year cost to subsequent-year cost from the RIA for the original section 313 rulemaking (USEPA, 1988). That RIA estimated the time required to complete a report in the first year to be 147 percent of the time required in subsequent years.[6] Applying this factor to the report completion estimate above, the time estimate required for reporting in the first year is 69.1 hours per report. Assuming the same labor mix as in the ICR update, the 69.1 hours is assumed to be comprised of 20.9 hours of management time, 45.2 hours of technical time, and 2.9 hours of clerical time.

The estimated number of reports to be filed by each industry is indicated in Table 4-2 for each option. The total cost associated with Form R completion is calculated by multiplying the unit cost indicated in Table 4-2 by the number of expected reports under each option.

[6]The first-year time estimates for completing a Form R and for conducting a compliance determination were estimated separately, and thus differently, in the RIA for the original rulemaking for section 313. As a result, the methodology for estimating the first-year costs differs for these activities.

Mailing and Recordkeeping

After a facility has completed the form, it incurs additional labor costs for recordkeeping associated with filing a Form R. Recordkeeping allows a facility to use the information in making calculations in subsequent years, and as documentation in the event it receives a compliance audit. Facilities must maintain records such as estimation methodology and calculations, engineering reports, inventory, incident and operating logs, and any other supporting materials needed to provide the information required on the Form R.

Mailing and recordkeeping require five hours per Form Rs (four hours of technical and one hour of clerical time)(USEPA, 1997). Recordkeeping and mailing costs are not expected to vary between the first and subsequent years. Therefore, the five hours per Form R is assumed for both first and subsequent years. The estimated number of reports requiring recordkeeping and mailing is identical to the number of Form Rs expected to be filed as presented in Table 4-2. Appendices B through K describe how the number of reports was estimated for each industry group.

4.1.3 TOTAL INDUSTRY COSTS

The total industry costs include the costs of rule familiarization, compliance determination, supplier notification, Form R completion, recordkeeping, and mailing. To compute the industry-wide cost of each compliance activity, the unit cost for each task is multiplied by the relevant number of facilities and/or reports associated with that task. Tables 4-8a and 4-8b present the total cost of the final rule in the first and subsequent years for the affected industry groups under Option 1. Tables 4-9a and 4-9b present the total cost of the final rule in the first and subsequent years under the selected option: Option 2. Tables 4-10a and 4-10b present the total cost of the final rule in the first and subsequent years under Option 3. Finally, Tables 4-11a and 4-11b present the total cost of the final rule in the first and subsequent years under Option 4.

TABLE 4-8a
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 1 - FIRST YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$109	$628	$37	$0	$774
12-Coal Mining (except 1241)	$0	$710	$1,540	$91	$0	$2,340
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$397	$20,124	$1,187	$0	$21,708
4953-RCRA Subtitle C TSDF's Only	$0	$66	$1,031	$61	$0	$1,158
5169-Chemical Wholesalers	$0	$1,137	$96	$6	$0	$1,239
5171-Bulk Petroleum	$0	$1,560	$31,443	$1,854	$0	$34,857
7389-Solvent Recovery Only	$0	$78	$470	$28	$0	$575
20-39 Manufacturing Industries	$19,397	$73,273	$149,767	$8,832	$68	$251,337
TOTAL	**$19,397**	**$77,330**	**$205,099**	**$12,096**	**$68**	**$313,987**

Totals may not equal the sum of all columns due to rounding

TABLE 4-8b
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 1 - SUBSEQUENT YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$27	$429	$37	$0	$493
12-Coal Mining (except 1241)	$0	$177	$1,051	$91	$0	$1,319
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$99	$13,737	$1,187	$0	$15,023
4953-RCRA Subtitle C TSDF's Only	$0	$16	$704	$61	$0	$781
5169-Chemical Wholesalers	$0	$284	$65	$6	$0	$355
5171-Bulk Petroleum	$0	$390	$21,463	$1,854	$0	$23,707
7389-Solvent Recovery Only	$0	$19	$321	$28	$0	$368
20-39 Manufacturing Industries	$0	$18,318	$102,231	$8,832	$68	$129,449
TOTAL	**$0**	**$19,330**	**$140,001**	**$12,096**	**$68**	**$171,496**

Totals may not equal the sum of all columns due to rounding

TABLE 4-9a
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 2 - FIRST YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$51	$388	$23	$0	$462
12-Coal Mining (except 1241)	$0	$332	$1,540	$91	$0	$1,962
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$185	$15,865	$936	$0	$16,986
4953-RCRA Subtitle C TSDF's Only	$0	$31	$969	$57	$0	$1,057
5169-Chemical Wholesalers	$0	$531	$67	$4	$0	$603
5171-Bulk Petroleum	$0	$729	$16,733	$987	$0	$18,449
7389-Solvent Recovery Only	$0	$36	$460	$27	$0	$524
20-39 Manufacturing Industries	$7,751	$34,251	$59,850	$3,529	$68	$105,451
TOTAL	**$7,751**	**$36,146**	**$95,872**	**$5,654**	**$68**	**$145,494**

Totals may not equal the sum of all columns due to rounding

TABLE 4-9b
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 2 - SUBSEQUENT YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$13	$265	$23	$0	$301
12-Coal Mining (except 1241)	$0	$83	$1,051	$91	$0	$1,225
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$46	$10,830	$936	$0	$11,812
4953-RCRA Subtitle C TSDF's Only	$0	$8	$661	$57	$0	$726
5169-Chemical Wholesalers	$0	$133	$46	$4	$0	$183
5171-Bulk Petroleum	$0	$182	$11,422	$987	$0	$12,591
7389-Solvent Recovery Only	$0	$9	$314	$27	$0	$350
20-39 Manufacturing Industries	$0	$8,563	$40,854	$3,529	$68	$53,014
TOTAL	**$0**	**$9,037**	**$65,443**	**$5,654**	**$68**	**$80,202**

Totals may not equal the sum of all columns due to rounding

TABLE 4-10a
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 3 - FIRST YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$25	$221	$13	$0	$258
12-Coal Mining (except 1241)	$0	$161	$1,540	$91	$0	$1,791
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$90	$11,448	$675	$0	$12,213
4953-RCRA Subtitle C TSDF's Only	$0	$15	$887	$52	$0	$954
5169-Chemical Wholesalers	$0	$257	$67	$4	$0	$328
5171-Bulk Petroleum	$0	$353	$8,072	$476	$0	$8,901
7389-Solvent Recovery Only	$0	$18	$0	$0	$0	$18
20-39 Manufacturing Industries	$3,131	$16,579	$24,172	$1,425	$68	$45,376
TOTAL	**$3,131**	**$17,498**	**$46,407**	**$2,736**	**$68**	**$69,839**

Totals may not equal the sum of all columns due to rounding

TABLE 4-10b
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 3 - SUBSEQUENT YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$6	$151	$13	$0	$170
12-Coal Mining (except 1241)	$0	$40	$1,051	$91	$0	$1,182
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$22	$7,815	$675	$0	$8,512
4953-RCRA Subtitle C TSDF's Only	$0	$4	$606	$52	$0	$662
5169-Chemical Wholesalers	$0	$64	$46	$4	$0	$114
5171-Bulk Petroleum	$0	$88	$5,510	$476	$0	$6,074
7389-Solvent Recovery Only	$0	$4	$0	$0	$0	$4
20-39 Manufacturing Industries	$0	$4,145	$16,500	$1,425	$68	$22,138
TOTAL	**$0**	**$4,373**	**$31,679**	**$2,736**	**$68**	**$38,856**

Totals may not equal the sum of all columns due to rounding

TABLE 4-11a
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 4 - FIRST YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$17	$29	$2	$0	$48
12-Coal Mining (except 1241)	$0	$112	$1,540	$91	$0	$1,743
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$63	$8,451	$498	$0	$9,012
4953-RCRA Subtitle C TSDF's Only	$0	$10	$513	$30	$0	$554
5169-Chemical Wholesalers	$0	$180	$67	$4	$0	$251
5171-Bulk Petroleum	$0	$247	$4,700	$277	$0	$5,224
7389-Solvent Recovery Only	$0	$12	$0	$0	$0	$12
20-39 Manufacturing Industries	$2,225	$11,603	$17,179	$1,013	$68	$32,089
TOTAL	**$2,225**	**$12,244**	**$32,479**	**$1,915**	**$68**	**$48,933**

Totals may not equal the sum of all columns due to rounding

TABLE 4-11b
DISTRIBUTION OF ESTIMATED COSTS BY COMPLIANCE ACTIVITY
OPTION 4 - SUBSEQUENT YEAR

SIC Code	Rule Familiarization ($ Thousands)	Compliance Determination ($ Thousands)	Form R Completion ($ Thousands)	Recordkeeping/ Mailing ($ Thousands)	Supplier Notification ($ Thousands)	Total ($ Thousands)
10-Metal Mining (except 1011,1081,1094)	$0	$4	$20	$2	$0	$26
12-Coal Mining (except 1241)	$0	$28	$1,051	$91	$0	$1,170
4911/4931/4939-Electric Services (Coal and Oil Facilities only)	$0	$16	$5,768	$498	$0	$6,282
4953-RCRA Subtitle C TSDF's Only	$0	$3	$350	$30	$0	$383
5169-Chemical Wholesalers	$0	$45	$46	$4	$0	$95
5171-Bulk Petroleum	$0	$62	$3,208	$277	$0	$3,547
7389-Solvent Recovery Only	$0	$3	$0	$0	$0	$3
20-39 Manufacturing Industries	$0	$2,901	$11,727	$1,013	$68	$15,709
TOTAL	**$0**	**$3,062**	**$22,170**	**$1,915**	**$68**	**$27,215**

Totals may not equal the sum of all columns due to rounding

4.1.4 COSTS FOR PUBLICLY-OWNED FACILITIES

Municipal electric utilities in SIC code 4911 are the only publicly-owned facilities expected to be affected under the final rule. Table 4-12 presents the estimated number of municipal electric utilities affected under the final rule and the estimated number of reports from these facilities. Table 4-13 presents the cost to these facilities for the first year and for subsequent years. These facilities, reports, and costs are included in the electric services (SIC codes 4911, 4931, and 4939) estimates in the other summary tables in this chapter.

TABLE 4-12
REPORTING ESTIMATES FOR PUBLICLY-OWNED FACILITIES
FINAL RULE - ALL OPTIONS

Option	Facilities Affected	Total Reports
Option 1	48	172
Option 2 (Selected)	44	125
Option 3	35	81
Option 4	22	42

TABLE 4-13
ESTIMATED COSTS FOR PUBLICLY-OWNED FACILITIES
ALL OPTIONS
(Thousands of 1998 dollars)

Option	First Year	Subsequent Years
Option 1	$893	$617
Option 2 (Selected)	$644	$447
Option 3	$416	$289
Option 4	$216	$150

4.1.5 TRANSFER PAYMENTS AND NON-MONETIZED COSTS

There are various state and federal requirements that are linked to the EPCRA section 313 reporting requirements. The associated requirements include state taxes and fees, state pollution prevention planning requirements, and special requirements for certain National Pollutant Discharge Elimination System (NPDES) storm water permits. These requirements are discussed in Appendix L (Associated Requirements). The costs calculated in this chapter include only those activities that are required by this rule. Although the fees, taxes, and pollution prevention requirements are linked to EPCRA section 313 reporting, they are not required by this rulemaking.

4.2 EPA COSTS

This section examines costs EPA would incur under the final rule. By adding certain PBT chemicals to the list of reportable TRI chemicals and by lowering the thresholds for certain PBT chemicals, EPA will incur costs for data processing, outreach and training, information dissemination, policy and petitions, and compliance and enforcement. These activities require additional EPA personnel, as well as extramural funds (for example, for contractors to perform data processing).

One way to characterize EPA's resource requirements is in terms of the number of data elements that must be processed. A data element is a single unit of information reported on Form R, such as the facility address or the number of pounds of the chemical released to air, that is entered into the TRI Information Management System. There are an average of 103 data elements entered into the system for each Form R. EPA is estimated to require 2.61 employees (also known as full time equivalents, or FTEs) and $551,600 in extramural funds for each additional million data elements that are added.[7] Assuming that half of the EPA employees are at the general pay scale grade 12 (i.e., GS-12, at a salary of $47,066) and half are at grade 13 (i.e., GS-13, at a salary of $55,969), and using a loading factor of 1.6 to account for employee benefits and other cost factors, yields an estimated annual cost of $82,428 per EPA employee.

Based on the number of reports predicted for the selected option, and assuming that these reports will also contain an average of 103 data elements each, this yields an estimate of 2.06 million data elements. This translates into an estimate of $1.6 million per year for EPA costs in subsequent years. These results are summarized in Table 4-14. The additional first-year costs to be incurred by EPA for outreach, training, and guidance are roughly estimated at $400,000. These costs are expected to be incurred in the first year only and are in addition to the costs presented in Table 4-14.

[7]See Appendix K of the *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313 Reporting (*April, 1997) for details of EPA's employee and cost model for TRI.

TABLE 4-14
SUMMARY OF INCREMENTAL EPA COSTS
SELECTED OPTION
(Thousands of 1998 dollars)

DESCRIPTION	FINAL RULE
# Data Elements	2.06 million
FTEs	5.4
Cost of FTEs	$443
Extramural Cost	$1,136
Total EPA Costs	**$1,579**

4.3 TOTAL COSTS

The estimated total cost to industry and EPA of the final rule is $147 million in the first year and $82 million in subsequent years. Table 4-15 summarizes the total costs to industry and EPA of the final rule.

TABLE 4-15
SUMMARY OF TOTAL COSTS
FINAL RULE
(Millions of 1998 dollars)

DESCRIPTION	First Year	Subsequent Years
Industry Costs	$145	$80
EPA Costs	$2.0	$1.6
TOTAL COSTS	$147	$82

LITERATURE CITED

1. U.S. Department of Commerce, Bureau of the Census. 1995 County Business Patterns, Washington, D.C.: Government Printing Office, 1995.

2. U.S. Department of Labor, Bureau of Labor Statistics. Employer Costs for Employee Compensation — March 1997. U.S. Department of Labor, Washington D.C., October 21. USDL News Release: 97-371, Table 11, 1997

3. U.S. Department of Labor, Bureau of Labor Statistics (1988). Employment Cost Index—March 1998. U.S. Department of Labor, Washington D.C., April 30. USDL News Release 98-170, Table 6, 1998.

4. U.S. Department of Labor, Bureau of Labor Statistics. Occupational Compensation Survey, National Summary 1996 (1998). U.S. Department of Labor, Washington, D.C., March. Bulletin 2497, Tables A-1, D-1 and D-3, 1998.

5. U.S. EPA/Office of Toxic Substances. Memorandum from J. Karnes to Brian Muehling on Updating of Unit Labor Costs to Reflect Inflation and Industry Comments for CAIR, Centaur Associates Inc. May 28, 1987.

6. U.S. EPA. Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313 Reporting. April, 1997.

7. U.S. EPA. Regulatory Impact Analysis in Support of Final Rulemaking Under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (1988). Prepared by ICF Incorporated. February, 1988.

8. U.S. EPA. Regulatory Impact Analysis of the EPCRA Section 313 Alternate Threshold Final Rule. November 18, 1994.

9. U.S. EPA. Regulatory Impact Analysis of the Final Rule to Add Various Chemicals and Chemical Categories to the EPCRA Section 313 List of Toxic Chemicals. November 18, 1994.

10. U.S. EPA. Review and Update of Burden and Cost Estimates for EPA's Toxics Release Inventory Program. August, 1993.

CHAPTER 5
ESTIMATED IMPACTS OF THE RULE

This chapter addresses the potential impacts of the final rule on small entities, as well as on certain demographic groups. Section 5.1 provides a description of the potential impacts on small entities. Section 5.2 considers whether the final rule adversely affects minorities and/or disadvantaged populations or children.

5.1 IMPACTS ON SMALL ENTITIES

The Regulatory Flexibility Act (RFA) of 1980 (5 U.S.C. § 601 *et. seq.*) requires Federal agencies to assess the effects of regulations on small entities and, in some instances, to examine alternatives to the regulations that may reduce adverse economic effects on significantly impacted small entities. The RFA requires agencies to prepare an initial and final regulatory flexibility analysis for each rule unless the Agency certifies that the rule will not have a significant economic impact on a substantial number of small entities.

Since 1980, the RFA has required Federal agencies to assess the economic impacts of their actions on small entities, including businesses, nonprofit agencies, and governments. Section 604 of the RFA, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires EPA to perform a final regulatory flexibility analysis for the final rule unless the Agency certifies under section 605(b) that the regulatory action will not have a significant economic impact on a substantial number of small entities. The RFA does not specifically define "a significant economic impact on a substantial number" of small entities.

Section 5.1.1 provides the definition of a small entity for each industry group covered under the final rule. Section 5.1.2 describes the general methodology used to determine if the final rule results in significant economic impacts on a substantial number of small entities. Section 5.1.3 describes the revenue data used in this analysis. Section 5.1.3 describes the specific approach used to analyze the impacts on each industry group and presents the results for each of these analyses. Section 5.1.5 summarizes the results for all small entities affected under the final rule.

5.1.1 DEFINITIONS OF SMALL ENTITIES

The RFA utilizes the definition of "small business" found in the Small Business Act, which authorizes the Small Business Administration (SBA) to further define "small business" by

regulation. For this analysis, EPA is using the Small Business Administration's (SBA's) definition of a small business for each industry.[1]

SBA's small business size standards vary by industry. In establishing size standards, SBA considers a number of economic and market characteristics that may allow a business concern to exercise dominance in an industry. Size standards are based on criteria, such as annual receipts or number of employees, that represent a measure of these characteristics. These standards represent the largest size that a for-profit enterprise (together with its affiliates) may be and qualify as a small business. For the industries included in this analysis, the definitions are as follows:

• Metal mining (SIC code 10)	500 employees
• Coal mining (SIC code 12)	500 employees
• Electric services (SIC code 4911)	4 million megawatt hours
• Electric and other services (SIC code 4931)	$5.0 million in annual receipts
• Combination utilities (SIC code 4939)	$5.0 million in annual receipts
• Commercial Hazardous Waste Treatment (SIC code 4953)	$6.0 million in annual receipts
• Chemical and allied products (SIC code 5169)	100 employees
• Petroleum bulk stations & terminals (SIC code 5171)	100 employees
• Business services (SIC code 7389)	$5.0 million in annual receipts
• Manufacturing (SIC codes 20 - 39)	500 employees

The SBA small business size standards are expansive, classifying most businesses as "small." For example, the default SBA size standard for manufacturing industries is 500 employees. According to information compiled for SBA by the Bureau of the Census for 1996, 327,642 of 332,565 firms have fewer than 500 employees (SBA, 1999). Therefore, at least 98.5 percent of firms would be classified as small businesses according to the SBA definition. In fact, this percentage is actually higher, since for certain SIC codes within manufacturing, the SBA size standard is 750, 1,000, or 1,500 employees.

The RFA defines "small governmental jurisdictions" as governments of cities, counties, towns, school districts, or special districts with a population of less than 50,000 people. This analysis applies this definition of a small governmental jurisdiction in evaluating the impacts on publicly-owned establishments affected by this rulemaking (i.e., municipally-owned electric utilities).

[1] SBA's most recent revisions to its "size standards" can be found in the January 31, 1996 Federal Register (61 FR 3175). Several minor corrections were published subsequent to the January notice. The SBA Internet site contains the corrected standards. The Internet address is: http://www.sbaonline.sba.gov/gopher/Financial-Assistance/Size-Standards.

The RFA defines “small organizations” as any “not-for-profit enterprise which is independently owned and operated and is not dominant in its field.” No small organizations are expected to report on PBT chemicals as a result of the final rule.

5.1.2 METHODOLOGY OVERVIEW

This analysis uses annual cost impact percentages to measure potential impacts on small entities. The cost impact percentage is defined as annual compliance costs as a percentage of annual revenues or sales. This approach is based on the premise that the cost impact percentage is an appropriate measure of a firm's ability to afford the costs attributable to a regulatory change. For purposes of determining small entity impacts, comparing annual compliance costs to annual revenues provides a reasonable indication of the magnitude of the regulatory burden relative to a commonly available and objective measure of a company's business volume. Where regulatory costs represent a very small fraction of a typical firm's revenue, the impacts of the regulation are likely to be minimal.

The cost impact percentages are calculated using both the first- and subsequent-year compliance costs. As explained in Chapter 4, annual compliance costs are composed of facility- and report-specific costs. Facility-specific costs such as compliance determination and rule familiarization do not vary with the number of reports filed. Report-specific costs such as Form R completion and recordkeeping vary according to the number of reports a facility files.

The general methodology followed to estimate the impacts on small entities consists of following steps:

(1) Obtain company-level annual revenue data;

(2) Develop company-level annual compliance cost estimates, based on the number of facilities per company and the number of reports per facility;

(3) Estimate the company-level impact percentages, defined as annual compliance costs as a percentage of annual revenues, as a measure of regulatory burden;

(4) Estimate the number of small companies affected (i.e., the number of small companies with at least one reporting facility);

(5) Estimate the percentage and number of small companies with company-level annual impact percentages in each of three categories: (1) less than one percent; (2) between one and three percent; and (3) greater than or equal to three percent.

The resolution of the analysis varies somewhat by industry group depending on the level of aggregation of compliance costs for each industry. Not all affected industry groups were analyzed at the 4-digit SIC code level. Specifically, the impacts on SIC codes 10 and 12 are examined at the two-digit level. SIC codes 20-39 are examined as a composite for all manufacturing. SIC codes 5169 and 5171 are examined at the four-digit level. For coal- and oil-

fired electric services (SIC codes 4911, 4931, and 4939), RCRA subtitle C facilities (SIC code 4953), and solvent recovery services (SIC code 7389), the analysis examines the impacts on only the specific portions of the industry groups subject to TRI reporting. In the following sections, the analysis and results for each industry group are described. In addition, there is a section describing the analysis of the impacts on publicly-owned entities.

5.1.3 GENERATION OF COMPANY REVENUE DATA

This section describes how employment and revenue data were developed for companies in affected industries. For most industry groups, this analysis does not predict which specific companies have facilities that are expected to report on PBT chemicals. Rather, the general approach is to construct industry group profiles that represent potential reporting companies. These profiles are then used to estimate the employment and revenues of the parent companies of potentially affected facilities and to estimate the percentage of parent companies classified as large or small.

For SIC codes 20-39 it is assumed that manufacturing facilities expected to file for the PBT chemicals are similar to current reporters in terms of employment and revenues. Therefore, employment and revenue profiles are constructed for parent companies of current TRI reporters and are then used in this analysis to represent parent companies of facilities expected to report on PBT chemicals. For all other SIC codes except 4911, 4953, and 7389, employment and revenue profiles were created using D&B data for every facility with more than 10 FTEs in the affected SIC codes, even though not all of the facilities are expected to report. It is assumed, however, that the facilities that do report have characteristics similar to the larger group. For 4911, 4953, and 7389, a more specific list of facilities based on other reporting criteria was used to identify facilities likely to report. Employment and revenue profiles were then created using D&B data for these facilities.

Company employment and revenue data were obtained for commercial facilities in the industry groups affected by the final rule from *Dun and Bradstreet's Market Identifiers On-Line Data Base* and *Dun's Marketing Services*, both services of Dun and Bradstreet (D&B). For over 11 million business locations, D&B provides data such as:

- Number of employees
- Line of business
- Key financial indicators
- Parent/headquarters

as well as many other variables. Employment and revenue data for commercial facilities in the manufacturing SIC codes (20-39) and in SIC code 7389 were obtained from a March 1998 version of *Dun's Marketing Services* which was the latest version available through EPA's Mainframe computer at the time of this analysis. Dun and Bradstreet data for August of 1995 were obtained for SIC codes 10, 12, 4911, 4931, 4939, 4953, 5169, and 5171 as part of the TRI industry expansion economic analysis. For manufacturers and solvent recyclers, revenue figures were obtained in 1998 dollars. For the remaining SIC codes, all revenue figures were either

obtained in 1995 dollars or converted to 1995 dollars using the implicit price deflator for the U.S. Gross Domestic Product.

EPA accesses *Dun's Marketing Services* through the FINDS system located on the Agency's IBM mainframe computer. The FINDS system contains selected D&B variables and contains no financial data other than revenue figures. The D&B data base uses the Standard Industrial Classification (SIC) code system to categorize business establishments based on the type of activity undertaken at that location. The employment and revenue data used in this analysis represent data for ultimate parent companies that own one or more establishments with a *primary* SIC code matching one of the SIC codes covered under the final rule.[2,3] As mentioned above, for SIC codes 20-39 it is assumed that manufacturing facilities expected to file for PBT chemicals are similar to current reporters in terms of employment and revenues. Therefore, current TRI reporters were identified in D&B. Employment and revenue data was obtained for the ultimate parent companies linked to these facilities. For SIC codes 10, 12, 4931, 4939, 5169 and 5171, the analysis identified all establishments listed in D&B with a matching SIC code, based on the establishment's primary SIC code classification, and obtained employment and revenue information for the establishment's ultimate parent company.[4] For SIC codes 4953 and 7389, the analysis identified the potential reporters in D&B and obtained employment and revenue information for the establishment's ultimate parent company.

Using the employment and revenue profiles, parent companies in each industry group were classified as small or large (based on SBA definitions). Annual revenue quartiles were determined for each size class and industry group. Information on the average number of facilities per parent company was also collected for the industry group as a whole and for small and large companies within the industry group.

For most industry groups it was not possible to identify the specific facilities expected to report. In the case of coal- and oil-fired electric power generating facilities in SIC code 4911, information was available for a specific list of facilities expected to report. From the list of facilities expected to report, the analysis obtained the number of employees and annual revenue for the ultimate parent company associated with each individual establishment. For SIC code

---

[2] A facility with multiple SIC codes is subject to TRI if the largest share of its revenue is from a covered SIC code, or if the total value of revenues derived from covered SIC codes represents a majority of the facility's revenues. It is not possible to determine whether a facility would be subject to reporting based on the Dun & Bradstreet SIC code listing alone. Dun's contains a primary SIC code and up to five additional (secondary) SIC codes; each SIC code represents a minimum of 10 percent of the location's revenue. For this analysis, it was assumed that the primary SIC code represents the largest share of a facility's operations, and thus a facility with a primary SIC code covered by the final rule was assumed to be subject to TRI reporting.

[3] The ultimate parent is the uppermost parent or headquarters that encompasses all directly related branches, subsidiaries or parents of a specific business. For the purposes of this analysis, establishments in Dun's were assumed to correspond to facilities in TRI.

[4] The employee and revenue data used for SIC code 12 (Coal mining) include all operations except those in SIC code 1241, while the facilities actually expected to report only includes facilities with coal preparation operations.

4911, it was not necessary to construct revenue quartiles, rather small entity impacts were estimated for the parent companies of coal and oil-fired electric utilities affected by the PBT rule.

The analysis accounts for parent companies owning more than one affected facility to obtain a list of unique ultimate parent companies. Consistent with the SBA size standards, the ultimate parent data obtained include available data on employees and revenues of all subsidiaries, divisions and branches of that parent, including those not individually affected under the final rule. The estimated number of facilities per ultimate parent, however, represents the number of facilities owned by that parent company that are classified in the affected SIC code or industry group (not the total number of facilities per parent company).

The information outlined in this section on company size, company revenues, and numbers of reporting facilities per company are used in the following sections to estimate small entity impacts.

5.1.4 ESTIMATING SMALL COMPANY IMPACTS

To evaluate the potential burden of the final PBT rule, annual compliance costs are estimated at the company level to be consistent with the financial data generated from D&B and other sources. For purposes of evaluating the impacts on small entities, an "affected" facility is defined as a facility that will submit at least one report as a result of the final rule. Thus, an "affected" company under this analysis is defined as a company owning at least one "affected" facility. In the next section, the impacts to industry groups for which revenue quartiles were generated are estimated. Impacts to SIC code 4911 are estimated in the subsequent section.

SIC codes 10, 12, 20-39, 4931, 4939, 4953, 5169, 5171, and 7389

The analysis of small entity impacts for these SIC codes uses (1) a range of reports per facility,[5] (2) the average number of facilities per company for small companies, and (3) the annual revenue for the 25th, 50th, and 75th percentage quartile for small companies. For SIC codes 10, 12, 20-39, 4931, 4939, 5169, and 5171, the revenue data and average number of locations per small company were estimated from the analysis of the Dun and Bradstreet data, as described in Section 5.1.3. For SIC code 4953, the revenue and average number of facilities per parent

[5] This analysis assumes that a facility, as defined under TRI, is equivalent to a location as defined by D&B. A "facility," for TRI reporting purposes, is defined under section 313 as a single reporting entity with contiguous or adjacent sites owned or operated by the same person that is classified under a SIC code covered by the regulations, has 10 or more full-time employees, and manufactures, processes or otherwise uses any of the listed toxic chemicals or chemical categories above the specific threshold quantities. For some industries this may not correspond exactly to the definition of a location by D&B.

company were obtained from D&B for a subset of facilities expected to report to TRI.[6] For SIC code 7389, the revenue and average number of facilities per parent company were estimated from 1998 D&B data obtained for 52 solvent recovery facilities identified in *EI Digest*.[7] Chapter 3 and Appendices B through K describe how the number of reports per facility was estimated for each PBT chemical and for each industry.

Table 5-1 presents the range of reports per facility (defined as the minimum to the maximum number of reports per facility) for each industry group. Based on these ranges, compliance cost estimates were developed for each possible number of reports per facility. Note that the same range of reports per facility is assumed for both large and small companies. This assumption is expected to overestimate impacts on small companies because small companies are less likely to exceed reporting thresholds for multiple PBT chemicals than large companies, which have more extensive and diverse operations.

Table 5-2 presents the first-year and subsequent-year company-level cost impact percentages for the range of reports per facility for the 25th, 50th, and 75th percent quartiles for small and large companies in SIC codes 10, 12, 20 - 39, 4931, 4939, 4953, 5169, 5171, and 7389 under the selected option (Option 2).

Estimating the Number of Small Companies Affected

To estimate the number of small companies affected, EPA used the following approach:

Step 1: Estimate the total number of companies (all sizes) affected by dividing the estimated number of affected facilities in each industry by the average number of facilities per parent for the industry as a whole. The average number of facilities per parent for SIC codes 10, 12, 20-39, 4931, 4939, 4953, 5169, 5171, and 7389 was obtained from the analysis of the Dun and Bradstreet data base as described in Section 5.1.4.

Step 2: Divide the estimated number of companies (all sizes) into size categories (in this case, large and small as defined by SBA) using the distribution of large and small companies for each industry as indicated from the Dun and Bradstreet data described in Section 5.1.4.

[6] The TRI Industry Expansion analysis identified 162 facilities in SIC code 4953 expected to report. Of the 162, 150 were matched to 76 unique ultimate parent companies. Of these 76 ultimate parents, the Duns data base included revenue data for 59 (six of which were small according to the SBA definitions), accounting for 127 facilities. Based on this data, the analysis estimated that the 162 facilities in the industry have 82 parent companies, of which 8 are small.

[7] As described in 5.1.3, this group of facilities (and associated parent companies) is expected to be representative of facilities that may report as a result of the final rule.

Table 5-3 presents the inputs and results of these calculations for each industry under the selected option.

TABLE 5-1
RANGE OF REPORTS PER FACILITY AND
AVERAGE NUMBER OF FACILITIES PER COMPANY

SIC Code	Average Number of Facilities Per Company		Option 2 (Selected)
	Small Companies	Large Companies	Range of Reports per Facility
10 — Metal Mining (except 1011, 1081, 1094)	1.15	2.52	1
12 — Coal Mining (except 1241)	1.09	3.60	1
4931 — Electric and Other Services	1.00	3.12	1 - 7
4939 — Combination Utilities	1.00	1.75	1 - 7
4953 — RCRA Subtitle C Hazardous Waste Facilities	1.17	2.26	1 - 7
5169 — Chemical Wholesalers	1.05	3.66	1
5171 — Bulk Petroleum Distributors	1.03	1.94	1 - 4
7389 — Solvent Recovery	1.10	1.20	1 - 3
20 - 39 — Manufacturing	1.11	3.66	1 - 15

TABLE 5 - 2
COMPANY-LEVEL COST IMPACT PERCENTAGES
PROPOSED OPTION - FIRST YEAR RANGE OF IMPACTS

SIC Code		Avg. # of Fac. / Company	Number of Reports per Facility		First Year Total Costs		25% Quartile Cost/Rev Ratio		Median Cost/Rev Ratio		75% Quartile Cost/Rev Ratio	
			Low	High	Low	High	Low	High	Low	High	Low	High
10	large	2.5	1	1	$ 14,420	$ 14,420	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	small	1.2	1	1	$ 6,581	$ 6,581	0.5%	0.5%	0.1%	0.1%	0.0%	0.0%
12	large	3.6	1	1	$ 20,600	$ 20,600	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	small	1.1	1	1	$ 6,237	$ 6,237	0.4%	0.4%	0.2%	0.2%	0.1%	0.1%
4931	large	3.1	1	7	$ 17,854	$ 112,931	0.1%	0.4%	0.0%	0.0%	0.0%	0.0%
	small	1.0	1	7	$ 5,722	$ 36,196	0.3%	2.0%	0.2%	1.1%	0.1%	0.9%
4939	large	1.8	1	7	$ 10,014	$ 63,342	0.1%	0.5%	0.0%	0.0%	0.0%	0.0%
	small	1.0	1	7	$ 5,722	$ 36,196	0.4%	2.4%	0.3%	1.9%	0.2%	1.3%
4953	large	2.3	1	7	$ 12,932	$ 81,802	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%
	small	1.2	1	7	$ 6,695	$ 42,349	0.2%	1.3%	0.2%	1.2%	0.1%	0.9%
5169	large	3.7	1	1	$ 20,944	$ 20,944	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	small	1.0	1	1	$ 6,008	$ 6,008	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%
5171	large	1.9	1	4	$ 11,101	$ 40,660	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
	small	1.0	1	4	$ 5,894	$ 21,588	0.1%	0.5%	0.1%	0.3%	0.0%	0.2%
7389	large	1.2	1	3	$ 6,867	$ 19,056	0.1%	0.2%	0.0%	0.1%	0.0%	0.0%
	small	1.1	1	3	$ 6,295	$ 17,468	0.5%	1.5%	0.3%	0.8%	0.2%	0.5%
20-39	large	3.7	1	15	$ 24,464	$ 284,706	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
	small	1.1	1	15	$ 7,419	$ 86,345	0.2%	2.2%	0.1%	0.9%	0.0%	0.3%

TABLE 5 - 2 CONTINUED
COMPANY-LEVEL COST IMPACT PERCENTAGES
PREFERRED OPTION - SUBSEQUENT YEAR RANGE OF IMPACTS

SIC Code		Avg. # of Fac. / Company	Number of Reports per Facility		Sub Year Total Costs		25% Quartile Cost/Rev Ratio		Median Cost/Rev Ratio		75% Quartile Cost/Rev Ratio	
			Low	High	Low	High	Low	High	Low	High	Low	High
10	large	2.5	1	1	$ 9,368	$ 9,368	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	small	1.2	1	1	$ 4,275	$ 4,275	0.3%	0.3%	0.1%	0.1%	0.0%	0.0%
12	large	3.6	1	1	$ 13,383	$ 13,383	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	small	1.1	1	1	$ 4,052	$ 4,052	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%
4931	large	3.1	1	7	$ 11,599	$ 78,179	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
	small	1.0	1	7	$ 3,717	$ 25,057	0.2%	1.4%	0.1%	0.8%	0.1%	0.6%
4939	large	1.8	1	7	$ 6,506	$ 43,850	0.1%	0.4%	0.0%	0.0%	0.0%	0.0%
	small	1.0	1	7	$ 3,717	$ 25,057	0.2%	1.7%	0.2%	1.3%	0.1%	0.9%
4953	large	2.3	1	7	$ 8,402	$ 56,629	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
	small	1.2	1	7	$ 4,349	$ 29,317	0.1%	0.9%	0.1%	0.8%	0.1%	0.7%
5169	large	3.7	1	1	$ 13,606	$ 13,606	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	small	1.0	1	1	$ 3,903	$ 3,903	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%
5171	large	1.9	1	4	$ 7,212	$ 27,912	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	small	1.0	1	4	$ 3,829	$ 14,819	0.1%	0.4%	0.1%	0.2%	0.0%	0.1%
7389	large	1.2	1	3	$ 4,461	$ 12,997	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
	small	1.1	1	3	$ 4,089	$ 11,914	0.3%	1.0%	0.2%	0.5%	0.1%	0.3%
20-39	large	3.7	1	15	$ 13,637	$ 195,878	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
	small	1.1	1	15	$ 4,136	$ 59,406	0.1%	1.5%	0.0%	0.6%	0.0%	0.2%

TABLE 5-3
ESTIMATED NUMBER OF AFFECTED SMALL ENTITIES
SELECTED OPTION

SIC Code	Estimated Number of Affected Facilities	Average Number of Facilities Per Parent	Estimated Number of Parent Entities	Estimated Percentage of Small Entities	Estimated Number of Small Entities
Industry					
10	81	1.9	42	60%	25
12	321	1.4	226	87%	197
4911	446	4.1	110	25%	27
4931	265	2.7	97	8%	8
4939	29	1.3	22	26%	6
4953	132	2.2	61	10%	6
5169	14	1.6	9	81%	7
5171	1,705	1.2	1,445	84%	1,214
7389	89	1.2	74	32%	24
20-39	8,131	1.9	4,213	68%	2,864
Municipal Utilities	44	1.3	34	44%	15
TOTAL	11,257	1.8	6,333	69%	4,393

Note: Due to rounding, calculations may not yield exact numbers.

Estimating Small Company Impacts

The number of small companies with impacts of 1) less than one percent, 2) between one percent and three percent, or 3) greater than or equal to three percent is estimated using a distribution of reports per facility and a distribution of companies by revenue level.

As described in Chapter 3, a distribution of the number of PBT reports filed per facility was developed for each SIC code. This distribution was then used to derive the number of unique facilities filing each possible number of reports. In the small entity analysis, the distribution of unique facilities for each SIC code (i.e., percent of facilities filing 1 report, percent of facilities filing 2 reports, etc) was used. This distribution was applied to the estimated number of affected small and large facilities from that industry group to distribute small and large facilities across the full range of potential reporting. For SIC codes where the unique number of facilities was capped

at the maximum, an even distribution of reporting across the full range of reports filed per facility was used.

Companies in each size class (large or small) were assumed to be evenly distributed between the first quartile (25%), middle quartile (50%), and third quartile (75%) of annual revenues for each industry group.[8] Assuming an even distribution of companies by revenue level implies that one-third of the companies are most like the 25th percent quartile company, one-third are most like the 50th percent, or median company, and one-third are most like the 75th percent quartile company. In contrast, a normal distribution would imply that more companies (i.e., greater than one-third) are most like the median company than like the 25th or 75th percent quartile company. Assuming an even distribution increases the estimated percentage (and number) of companies with lower revenues, and thus, with higher cost impacts.

Steps to Estimate Impacts

The magnitude of the impact of the final rule on a small company depends on (1) the number of facilities that a small company has, (2) the number of additional reports each facility files, and (3) the overall revenues of the small company. The methodology used to estimate the impact of the final rule on small companies includes five steps. For demonstration purposes, a simulated industry group (SIC code XXXX) is presented in the following exhibits to illustrate each step.

Step One

For each industry group, the distribution of reports per facility was obtained as described in Chapter 3. This distribution indicates the number of facilities that file one report, the number that file two reports, and so on. The number of reports that a facility files at a given threshold is related to the activities and characteristics of that facility. These characteristics may include the products manufactured at the facility, the processes undertaken, and the throughput of PBT chemicals. Exhibit 1 shows the *number* of facilities in SIC code XXXX that file each possible number of reports.

Exhibit 1

SIC Code XXXX

	Number of Reports per Facility		
Total Facilities	1	2	3
200	140	40	20

[8] The development of these quartiles was described in Section 5.1.3.

Step Two

Next, the *percentage* of total affected facilities filing each possible number of reports is calculated (see Exhibit 2). The number of TRI reports that a given facility files is not necessarily closely related to the size of that facility's parent company. A facility that files a single report may be the only facility owned by a small company, or it may be one of many facilities owned by a larger company. Therefore, for this analysis, it was assumed that the facilities in an industry group that are owned by small companies have the same distribution of reports per facility as facilities owned by large companies. For example, if 70 percent of all facilities in an industry group file 1 report, then it is assumed that 70 percent of facilities owned by small companies file 1 report and 70 percent of facilities owned by large companies file 1 report.[9] An application of this assumption is shown in Exhibit 2. This table shows that, of facilities filing reports, 70 percent file one report, 20 percent file two reports, and 10 percent file three reports.

Exhibit 2

SIC Code XXXX

Distribution by Size/# Reports		Number of Reports per Facility		
Company Size Class	Total Facilities	1	2	3
Small or Large	100%	(140/200) = 70%	(40/200) = 20%	(20/200)=10%

Step Three

Due to data limitations, it is not possible to predict the exact number of PBT chemical reports that individual facilities will file, to identify all affected facilities comprehensively, and to match all affected facilities to parent companies. Therefore, revenue quartiles were developed to characterize companies in each industry group. Revenue quartiles are developed so that company compliance costs (which will vary according to numbers of reports expected per facility and the average number of facilities per company) can be compared to an estimate of company revenues. This analysis assumes that one-third of the companies are most like the 25th percent quartile company, one-third are most like the 50th percent, or median company, and one-third are most like the 75th percent quartile company.

Next, the percentages of affected facilities in Exhibit 2 are divided evenly among three revenue quartiles (25%, 50%, 75%)(see Exhibit 3). This results in a conservative estimate of small

[9] In fact, this assumption may result in an overestimate of the number of reports that may be filed by facilities that are owned by small companies. An SIC code-specific analysis of current (1996) TRI reporting showed that facilities owned by small companies tended to file fewer reports than facilities owned by large companies.

entity impacts, since distributing facilities *evenly* across company revenue quartiles may result in an overestimate of impacts.[10]

Exhibit 3

SIC Code XXXX

Distribution by Size/Revenue/# Reports		Number of Reports per Facility		
Company Size class	Revenue Category	1	2	3
Small or Large	25%	23.3% of facilities	6.7% of facilities	3.3% of facilities
	50%	23.3% of facilities	6.7% of facilities	3.3% of facilities
	75%	23.3% of facilities	6.7% of facilities	3.3% of facilities

Step Four

In order to assess *company* level impacts, cost impact percentages are calculated for each possible combination of company level revenue and number of reports filed per facility. Company level cost impact percentages are based on total annual compliance costs divided by annual revenues at the company level. The impact percentages are calculated as follows:

$$\textit{Company Impact Percentage} = \left[\frac{\textit{Cost per Facility} \times \textit{Avg \# of Facilities per Company}}{\textit{Company Revenue}}\right] + \left[\frac{\textit{Avg \# of Facilities per Company} \times \textit{\# of Reports per Facility} \times \textit{Cost Per Report}}{\textit{Company Revenue}}\right]$$

[10] Facilities owned by smaller companies may actually submit fewer reports than facilities owned by larger companies. For many PBT chemicals, the number of reports a facility will file is related to fuel throughput. PBT chemicals are present in fuel at varying concentrations. Consequently, as fuel throughput increases, so will the number of PBT reports per facility at a given threshold. Throughput is typically related to production levels or other economic activity at a facility, thus facilities in a given SIC code with higher throughput (and more reports) would be expected to have higher revenues than facilities in the same SIC code with lower throughput (and fewer reports).

For example, if

cost per facility = $1,603, and
avg # of facilities per company = 2, and
so on, then:

$$0.5\% = \left[\frac{\$1{,}603 \times 2}{\$2{,}672{,}800}\right] + \left[\frac{2 \times 1 \times \$5{,}079}{\$2{,}672{,}800}\right]$$

Company cost impact percentages are presented in Exhibit 4.

Exhibit 4

SIC Code XXXX

Company Impact Percentages by Size/Revenue/# Reports			Number of Reports per Facility		
Company Size class	Avg # of Fac/Co.	Revenue Category	1	2	3
Small	2	25%	0.5%	1.5%	4.0%
	2	50%	0.1%	0.5%	2.0%
	2	75%	0.0%	0.1%	0.5%
Large	4	25%	0.0%	0.0%	0.0%
	4	50%	0.0%	0.0%	0.0%
	4	75%	0.0%	0.0%	0.0%

To determine the percentage of companies with cost impact percentages in each category, each cost impact percentage shown in Exhibit 4 is then compared to each of three impact categories: (1) less than one percent of annual revenues; (2) between one and three percent of annual revenues; (3) greater then three percent of annual revenues. For example, Exhibit 4 indicates that small companies in SIC code XXXX own an average of 2 facilities. If each of the facilities files one report, then a company with revenues at the 25% quartile would have a cost impact percentage of 0.5% at the company level.

In this analysis, a constant relationship exists between numbers of facilities and numbers of companies within each size class and revenue quartile: the *percentage of facilities* filing each possible number of reports equals the *percentage of companies* owning facilities that file each possible number of reports.

As an example, assume that there are 80 facilities in SIC code YYYY that file additional reports on PBT chemicals. If the average number of facilities per small company in SIC code YYYY equals 2, the total number of small companies equals 40. If twenty percent of the facilities file one report and are owned by small companies with revenues in the 25% quartile then 16 facilities (80 x 0.20 = 16) filing one report each are owned by small companies with revenues in the 25% quartile. Given the average of 2 facilities per company in SIC code YYYY,8 small companies or twenty percent (8/40 = 0.20) of the small companies have revenues in the 25% quartile and own 2 facilities that each file one report. Therefore, twenty percent of facilities file one report and are owned by small companies with revenues in the 25% quartile and twenty percent of small companies have revenues in the 25% quartile and own 2 facilities that each file one report.

Referring back to Exhibit 3, 23.3% of the facilities file one report and are associated with small companies with revenues in the 25% quartile. As explained above, it is appropriate to assume the same percentage of small companies have revenues in the 25% quartile and own 2 facilities that file one report each. Thus, as shown in Exhibit 5, 23.3% of the small companies incur cost impact percentages of 0.5%, which is less than one percent of annual revenues. In Exhibit 5, this same comparison is performed for each of the possible combinations of company-level revenues and numbers of reports per facility.

Exhibit 5

SIC Code XXX

Percent of Small Companies with Impact Percentages *Less than 1%*

			Number of Reports per Facility		
Company Size Class	Revenue Category	**Total %**	1	2	3
Small	25%	**23.3+0+0=23.3%**	[0.5% is not greater than 1%] therefore **23.3%**	[1.5% is greater than 1%] therefore **0%**	[4.0% is greater than 1%] therefore **0%**
	50%	**23.3+6.7+0=30.0%**	[0.1%is not greater than 1%] therefore **23.3%**	[0.5% is not greater than 1%] therefore **6.7%**	[2.0% is greater than 1%] therefore **0%**
	75%	**23.3+6.7+3.3=33.3%**	[0.0% is not greater than 1%] therefore **23.3%**	[0.1% is not greater than 1%] therefore **6.7%**	[0.5% is not greater than 1%] therefore **3.3%**
		86.6%			

Summing across all revenue quartile and number of reports per facility combinations in Exhibit 5 indicates that overall, 86.6% of small companies are expected to incur cost impact percentages of less than one percent. This exercise is repeated to determine the percentage of small companies with impact percentages between 1% and 3%, and with impact percentages above 3%.

Step Five

Finally, in Exhibit 6 the number of small companies in each of the three impact categories is calculated as the percentage of companies with cost impact percentages in each category multiplied by the total number of small companies in this SIC code as estimated in Table 5-3.

Exhibit 6

SIC Code XXXX					# of Small Companies w/ Impacts less than 1%	# of Small Companies w/ Impact between 1% & 3%	# of Small Companies w/ Impacts greater than 3%
# Fac.	Avg. Fac/ Co.	# Co.s	% Small	# Small Co.s			
200	2	100	60%	60	[86.6% x 60]= **52**	[10.1% x 60]= **6**	[3.3% x 60]=**2**

Table 5-4 presents the estimated number of small companies in each impact category.

TABLE 5-4
SUMMARY OF IMPACTS ON SMALL ENTITIES
FIRST YEAR
SELECTED OPTION

SIC Code	Estimated Number of Affected Entities	Estimated Number of Affected Small Entities	Estimated Number of Small Entities with Impacts of 3 Percent or Greater	Estimated Number of Small Entities with Impacts Between 1 and 3 Percent	Estimated Number of Small Entities with Impacts Less than 1 Percent
10	42	25	0	0	25
12	226	197	0	0	197
4911	110	27	0	0	27
4931	97	8	0	2	6
4939	22	6	0	3	3
4953	61	6	0	1	5
5169	9	7	0	0	7
5171	1,445	1,214	0	0	1,214
7389	74	24	0	0	24
20-39	4,213	2,864	0	11	2,853
Municipal Utilities	34	15	0	0	15
TOTAL	6,333	4,393	0	17	4,376
Percentage of Small Entities	—	100%	0%	0.4%	99.6%

Note: Due to rounding, calculations may not yield exact numbers.

TABLE 5-4 (Continued)
SUMMARY OF IMPACTS ON SMALL ENTITIES
SUBSEQUENT YEARS
SELECTED OPTION

SIC Code	Estimated Number of Affected Entities	Estimated Number of Affected Small Entities	Estimated Number of Small Entities with Impacts of 3 Percent or Greater	Estimated Number of Small Entities with Impacts Between 1 and 3 Percent	Estimated Number of Small Entities with Impacts Less than 1 Percent
10	42	25	0	0	25
12	226	197	0	0	197
4911	110	27	0	0	27
4931	97	8	0	1	7
4939	22	6	0	2	4
4953	61	6	0	0	6
5169	9	7	0	0	7
5171	1,445	1,214	0	0	1,214
7389	74	24	0	0	24
20-39	4,213	2,864	0	2	2,862
Municipal Utilities	34	15	0	0	15
TOTAL	6,333	4,393	0	5	4,388
Percentage of Small Entities	—	100%	0%	0.1%	99.9%

Note: Due to rounding, calculations may not yield exact numbers.

SIC Code 4911 (Coal- and Oil-Fired Steam Electric Services)

This industry group was analyzed separately because of the nature of the SBA definition of a small business for this industry and because it was possible to identify the actual facilities expected to report under the final rule. The SBA definition of a small business for this SIC code is four million megawatt hours (MWh) of electricity output annually. The analysis of this industry is based on a database of steam-generating power plants available from the Utility Data Institute (UDI).

To match the SBA size definition, which applies to the parent company and all subsidiaries, divisions and branches, it was necessary to aggregate the coal- and oil-fired power plants listed in the UDI database based on common ownership. Determining common ownership of these power generating facilities was accomplished by matching facilities listed in the UDI database with information in *Dun & Bradstreet's Market Identifiers On-line Database*, which provides a unique Dun's number for each location listed in the database and also indicates whether the location is a subsidiary, division or branch, or has a separate headquarters and/or immediate and ultimate parent. Some facilities in the UDI data base had no immediate or ultimate parent listed in the Dun & Bradstreet database. For these facilities, the owner listed in the UDI database was assumed to be the ultimate parent. By this method, all facilities sharing common ownership were aggregated under a single listing for the ultimate parent to the extent indicated by the data sources used. The 446 privately-owned electric utility facilities expected to submit additional TRI reports at the selected option were associated with 110 parent companies, indicating an average of 4.1 locations per parent company.

Financial and employee size data for each parent company were obtained from *Dun & Bradstreet's Market Identifiers On-line Database*. There were 49 companies for whom annual revenues could not be obtained at the parent level from Dun and Bradstreet. Revenue information for these companies was obtained from other data sources, including *Ward's Business Directory of U.S. Private and Public Companies, 1996 Directory of Corporate Affiliations,* and *Electrical World Directory of Electric Power Producers,* 104th edition.

The records were then sorted by annual production to determine the number of large and small companies based on the 4-million MWh SBA standard. For each parent company listing, the total estimated compliance burden was calculated based on the number of subsidiary facilities affected under the final rule and the number of reports expected from each facility.[11] The company-specific compliance cost estimates were developed using the estimated number of reports per facility presented in Chapter 3.

[11] The UDI data base includes only steam-electric generating facilities. Consequently, some parent companies listed may have additional non-steam generating capacity (e.g., hydro, wind) which should be included in their total annual production for purposes of determining if the company exceeds the SBA's 4-million MWh standard. This potential source of error would be expected to overcount the number of "small" companies in SIC code 4911.

The annual cost impact percentage (annual compliance costs as a percentage of annual revenues) was then estimated for each company as previously described. The cost impact percentages for each ultimate parent were classified into one of three categories as a measure of the potential regulatory burden: (1) less than one percent of annual revenues; (2) from one to three percent of annual revenues; and (3) three percent or more of annual revenues. Table 5-5 presents the results of this analysis for the Selected Option.

Publicly-Owned Facilities

This analysis examines the potential impacts on small municipalities that own one or more coal- and/or oil-fired electric utilities. Electric utilities are the only publicly-owned facilities expected to be affected under this rulemaking. A total of 49 municipally-owned electric utility facilities representing 39 unique municipally-owned parent entities were identified from the UDI data (USEPA, 1997). Of the 49 municipally-owned electric utility facilities, 44 facilities (owned by 34 unique municipalities) are expected to submit reports for PBT chemicals. The RFA defines a small governmental jurisdiction as having a population of less than 50,000 people. Population data for each municipality were obtained from *Electric World Directory of Electric Power Producers*, 104th edition, and from the *County and City Data Book: 1994*. Based on these population data, 15 affected small municipally-owned electric utility companies were identified, representing 15 individual facilities.

The number of reports for each electric utility was then estimated and compared against the utility's annual revenues. Annual revenue data were obtained from *Electrical World Directory of Electric Power Producers*, 104th edition. Revenue information was provided directly by four utilities for which published data were not available.[12]

Table 5-6 summarizes the results for small municipally-owned electric utilities.

[12] Utility revenues were examined, in place of annual governmental revenues, because revenue data were not available for several municipalities. Using utility revenue to examine the potential regulatory burden on these entities is expected to provide a more conservative estimate of the potential impacts on these small entities because the utility revenues represent only a portion of the total annual revenues for a municipality. Thus, it can be assumed that the cost impact percentage based on total annual municipal revenues will be lower than estimated when comparing utility compliance costs to utility revenues alone.

TABLE 5-5
ESTIMATED IMPACTS ON COAL- AND OIL-FIRED ELECTRIC SERVICES
SIC CODE 4911
SELECTED OPTION

Size Classification	Number of Companies[1]	Average Number of Reports per Facility	Range of Reports per Facility	Median Annual Sales (Millions)	Companies with Impacts of 3% of Annual Sales	Companies with Impacts of 1%-3% of Annual Sales	Companies with Impacts < 1% of Annual Sales
FIRST YEAR							
Large (> 4 Million MWh)	83	4	1 - 7	$1,367	0	0	83
Small (< 4 Million MWh)	27	4	1 - 7	$181	0	0	27
Total	110						110
SUBSEQUENT YEARS							
Large (> 4 Million MWh)	83	4	1 - 7	$1,367	0	0	83
Small (< 4 Million MWh)	27	4	1 - 7	$181	0	0	27
Total	110						110

[1] Of the 113 parent companies, 110 are expected to file reports on PBT chemicals.

TABLE 5-6
ESTIMATED IMPACTS FOR MUNICIPALLY-OWNED ELECTRIC UTILITIES
SIC CODE 4911
SELECTED OPTION

Size Classification	Number of Municipalities	Average Number of Reports per Municipally-owned Facility	Range of Reports per Municipally-owned Facility	Median Annual Sales[1] (Millions)	Municipalities with Impacts 3% of Annual Sales	Municipalities with Impacts of 1%-3% of Annual Sales	Municipalities with Impacts < 1% of Annual Sales
FIRST YEAR							
Small Municipalities (Pop. < 50,000)	15 [2]	3	1 - 6	$16.8	0	0	15
SUBSEQUENT YEARS							
Small Municipalities (Pop. < 50,000)	15 [2]	3	1 - 6	$16.8	0	0	15

[1] Median annual sales data is based on utility revenues, not total revenues for the municipalities owning the utilities.
[2] Of the 18 municipally-owned electric utility companies, 15 are expected to file reports on PBT chemicals.

5.1.5 SUMMARY OF SMALL ENTITY IMPACTS

This section summarizes the estimated impacts for all small entities based on the results of the industry-specific analyses discussed in previous sections. Table 5-3 presents the estimated number of affected small companies within each industry group and number of affected small municipalities. Table 5-4 presents the estimated number of small companies and small municipalities falling into each impact category as well as the overall results for all companies and municipalities affected the final rule. As Table 5-4 illustrates, the final rule is estimated to affect 4,393 small companies and municipalities. Of these small entities, 17 (0.4%) are expected to have impacts greater than or equal to one percent in the first year. None of the small entities will experience impacts of greater than three percent. In subsequent years, 5 (0.1%) of small entities may experience impacts above one percent. None of the small entities will experience impacts of greater than three percent.

5.2 IMPACTS ON CERTAIN DEMOGRAPHIC GROUPS

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires that all federal agencies address the issue of environmental justice by identifying and revising programs, policies, and activities that may disproportionately and adversely affect the health of minority or low income populations or their environments. Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks," requires that for rules that are economically significant under Executive Order 12866, federal agencies must, to the extent permitted by law and consistent with the agency's mission, identify and assess the environmental health risks and safety risks that may disproportionately affect children.

By lowering the section 313 reporting thresholds for PBT chemicals, EPA is providing communities across the United States (including low-income populations and minority populations) with access to data that may assist them in lowering exposures and consequently reducing chemical risks for themselves and their children. This information can also be used by government agencies and others to identify potential problems, set priorities, and take appropriate steps to reduce any potential risks to human health and the environment. Specific activities, such as information dissemination, exposure mitigation, pollution prevention, outreach and educational programs, and consumer protection programs, can be expected to benefit minority and economically disadvantaged groups even if the programs are not specifically targeting at these groups. The collection of this data will also assist in determining and responding to environmental health and safety risks to children. Therefore, the informational benefits of the final rule will have a positive impact on the human health and environmental impacts of minority populations, low-income populations, and children.

LITERATURE CITED

1. 1996 Directory of Corporate Affiliations (1996), volumes 1-5, New Providence: National Register Publishing, 1996.

2. "Directory of U.S. and Canadian Commercial Hazardous Waste Management Facilities," (1995), The Hazardous Waste Consultant. Elsevier Science Inc. March-April, 1995.

3. Dun & Bradstreet. Dun & Bradstreet's Market Identifiers On-line Data Base.

4. Dun & Bradstreet. Dun's Marketing Services Data Base. August, 1995.

5. Dun & Bradstreet. Dun's Marketing Services Data Base. March, 1998.

6. Electrical World Directory of Electric Power Producers (1995), 104th ed. New York: The McGraw-Hill Companies, 1995.

7. U.S. Department of Commerce, Bureau of the Census. County and City Data Book (1994). Washington, D.C.: Government Printing Office, 1994.

8. U.S. EPA. Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313 Reporting. April, 1997.

9. U.S. Small Business Administration 1999. Information from the Small Business Administration on the SBA World Wide Web site: http://www.sba.gov/advo/stats/us88_96i.pdf

10. Utility Data Institute. 1994 Production Costs: Operating Steam-Electric Plants (UDI-2011-95)(1995), 14th ed. September 1995.

11. Ward's Business Directory of U.S. Private and Public Companies, volumes 1-4 (1996). New York: Gale Research, Inc., 1996.

CHAPTER 6
BENEFITS

6.1 INTRODUCTION

In enacting the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 and the Pollution Prevention Act (PPA) of 1990, Congress recognized the significant benefits of providing information on the presence, releases and waste management of toxic chemicals. The Toxics Release Inventory (TRI) has proven to be one of the most powerful forces in empowering the federal government, state and local governments, industry, environmental groups and the general public to fully participate in an informed dialogue about the environmental impacts of toxic chemicals in the United States. The TRI has created a publicly available database that provides quantitative information on toxic chemical releases, transfers, recycling, and disposal. With the collection of this information starting in 1987 came the ability for the public, government, and the regulated community to understand the magnitude of chemical emissions in the United States, and to assess the need to reduce these releases and transfers. The TRI enables interested parties to establish credible baselines, to set realistic goals for environmental progress over time, and to measure progress in meeting these goals. The TRI system has become a neutral yardstick by which progress can be measured. This final rule to expand reporting on persistent bioaccumulative toxic (PBT) chemicals is intended to build upon past success of the TRI.

The information reported to TRI increases knowledge of the levels of pollutants released to the environment and the potential pathways of exposure, thereby improving scientific understanding of the health and environmental risks of toxic chemicals; allows the public to make better-informed decisions on matters such as where to work and live; enhances the ability of corporate leaders and purchasers to gauge a facility's potential environmental liabilities; and assists federal, state, and local authorities in making better decisions on acceptable levels of toxics. The benefits of the final rule include improvements in understanding, awareness, and decision making related to the provision and distribution of PBT chemical information.

Moreover, providing information can lead to follow-on activities that create additional costs and benefits (see Table 6-1). As evidenced by the current TRI reporting, this information can lead to voluntary initiatives by industry to review production processes, set goals for reductions in emissions, and institute "good neighbor" policies. If an individual facility owner or operator perceives that the benefits outweigh costs, then it will implement changes to reduce its use and/or releases of TRI chemicals.[1] Even when firms do not find it initially in their own interest to reduce releases, making TRI information available to the public may induce changes in the marketplace that provide incentives for firms to cut TRI chemical releases.

[1] Companies that participated in EPA's 33/50 program fall into this category.

TABLE 6-1
POTENTIAL BENEFITS AND COSTS ASSOCIATED WITH THE FINAL RULE AND WITH FOLLOW-ON ACTIVITIES

Consequences of Activities Required by the Proposed Rule		
Activity	**Activity**	**Benefits**
Companies file Form R	Government publishes TRI information, thus providing additional information on chemical releases to the public	Improved scientific understanding of environmental and health risks Increased public awareness More informed decision-making by government, industry and the public
[Industry cost]	[Government cost]	[Societal benefit]
Follow-On Activities (i.e., not required by the proposed rule)		
Activity	**Activity**	**Benefits**
Industry-initiated review of processes, goal-setting for reductions, institution of "good neighbor" policies, etc.	Implementation of changes in production, operation, and raw materials use by industry yield reductions in releases, treatment and disposal of waste	Reduced waste disposal costs for industry Reduced clean-up costs arising from accidental releases Reduced third-party liability risk (thus, decreased risk management costs to industry) Reduced environmental and human health risks Improved preservation of natural resources
[Industry cost]	[Industry cost]	[Societal benefit]

Social benefits derived from follow-on activities not required by the final rule may include decreased costs of waste treatment and disposal, lower probability of accidental releases and lower clean-up costs in the event of such releases, reduced contamination of natural resources from decreased land disposal, improved air and water quality, and reduced risks to human health such as lower incidence of cancer deaths and related medical care costs. Such social benefits are offset by the social costs to implement the changes, such as installing scrubbers and substituting materials that are less toxic but more expensive. These types of benefits may also be offset if a facility substitutes a more toxic chemical for a TRI listed chemical because the substitute is not a

listed substance, or uses and releases higher levels of a less toxic unlisted chemical resulting in increased levels of exposure and risk. The net social benefits of the information provided by the rule and the follow-on activities equal the difference between the benefits and the costs displayed in Table 6-1.

As discussed in Chapter 2, EPA is lowering EPCRA section 313 reporting thresholds for certain PBT chemicals. These chemicals meet the section 313 criteria of being acutely or chronically hazardous to human health or to the environment. A chemical's persistence refers to the length of time the chemical can exist in the environment before being destroyed by natural processes.[2] Chemicals can persist in all of the environmental media: air water, soil and sediment. Bioaccumulation is a general term that is used to describe the process by which organisms may accumulate certain chemicals in their bodies. The term refers to both uptake of chemicals from water and from ingested food and sediment residues.[3] Chemicals that persist and bioaccumulate have been found in shellfish, birds, mammals, and human adipose tissue.

Review of existing data leads EPA to believe that, as a general matter, the release to the environment of a toxic chemical that persists and bioaccumulates is of greater concern than the release of toxic chemicals that do not persist or bioaccumulate. Since PBT chemicals can remain in the environment for a significant amount of time and can accumulate in animal tissues, even relatively small releases of such chemicals from individual facilities have the potential to cause significant adverse impacts on human health and the environment. The availability of information on PBT chemicals is a critical component of a community's right-to-know. Therefore, it is important to gather and disseminate relevant information to the public on the releases and other waste management activities of PBT chemicals.

PBT chemical releases occur at facilities that manufacture, process, or otherwise use such chemicals in relatively small amounts. Under current reporting thresholds, important information about the releases and other waste management activities involving PBT chemicals are not being captured by the TRI. Thus, the public does not have all of the information needed to determine if PBT chemicals are present in their communities and whether these chemicals may pose a significant risk. By lowering reporting thresholds for PBT chemicals, EPA will assure that the public will have access to such data.

The value of reporting under the TRI program is not simply a function of the quantities reported, but in making the comprehensive and detailed TRI available to the public. Several factors suggest that the incremental benefits from the final rule are potentially large.

---

[2] Persistence in an individual medium is controlled by transport of the chemical to other media, as well as transformation to other chemical species. A common measure of persistence in an individual environmental medium is the chemical's half-life, or the amount of time necessary for half of the chemical present to be eliminated from the medium. After one half-life, half of the original amount of the chemical remains, after two half-lives one quarter of the original amount remains, and so on.

[3] EPA has defined bioaccumulation as the net accumulation of a substance by an organism as a result of uptake from all environmental sources (60 FR 15366, March 23, 1995).

First, the final rule will reduce reporting thresholds and add new chemicals. In a 1991 evaluation, the General Accounting Office (GAO) concluded that while the TRI provided useful information, it was not sufficiently comprehensive. In particular, GAO recommended that EPA consider the "health and environmental effects"of various chemicals in deciding how to enhance the TRI.[4] Atlas (1998) observed that current TRI reporting excludes important chemicals and that existing thresholds are so high that many facilities do not report their toxic chemical emissions. By adding certain new chemicals to the reportable list and lowering the thresholds for many others, the final rule will gather new and important data, and add to the overall value of the TRI.

Second, as described above, PBT chemicals remain in the environment for long periods of time, build up in the environment, particularly in food chains, and are toxic to humans, animals and plants. Tietenberg (1992) explains that the total damage and social costs associated with pollutants that accumulate in the environment is increasing over time because emissions in the current time period cause damages now and in each successive time period. In other words, even if annual emissions of PBT chemicals are held constant, the total concentration and the total damages will increase over time.

6.2 THEORETICAL BASIS FOR ESTIMATING BENEFITS

6.2.1 THEORETICAL FRAMEWORK FOR ASSESSMENT OF PBT INFORMATION BENEFITS

This section develops a framework for discussing economic benefits of information resulting from the final rule. As in past regulations implementing EPCRA section 313, the objective of the final rule is to correct market failures, which inhibit the ability of the traditional economic pricing system to maximize social welfare.[5] Pollutants must either be physically altered and/or diluted in the environment so as not to cause health or environmental damages. Significantly, the characteristics of PBT chemicals are counter to both of these conditions. The economic framework specifically accounts for the persistent and bioaccumulative nature of PBT chemicals. Persistence and bioaccumulation in the environment requires that the benefits analysis appropriately address time and the diverse group of resource users and uses that are affected. In other words, PBT chemicals represent a regional intertemporal pollution problem.[6]

PBT pollution suggests two distinct types of market failure: negative externalities and asymmetric information. The basic theory of negative externalities is described next. Following this, a theoretical description of the costs to society of asymmetric information is presented. With this theoretical foundation, the remainder of the chapter presents a more detailed description of

[4] GAO, 1991, page 31.

[5] It is a well established theory in modern economics that markets will fail to achieve socially optimal outcomes when differences exist between market and social values.

[6] See Tietenberg (1992), page 362 for a discussion of regional pollutants.

the manner in which the final rule will address these market failures through the enhancement of the TRI. Further, as part of this assessment, the ways in which social benefits are distributed across the various potential user and "non-user" groups of the TRI are examined.

PBT Chemicals as Negative Externalities

Negative externalities exist when a production process imposes uncompensated (or "external") costs on another party. In the performance of manufacturing and other business activities, entities may release pollutants or cause other environmental harm without accounting for the consequences of these actions. These costs are not recognized by the responsible entity in the conventional market-based accounting framework. For example, a company that produces and/or uses hazardous chemicals will pay for labor and capital but will not pay for environmental damages resulting from their emissions of these hazardous chemicals. Because these costs are not recognized by the responsible entity, they are not considered in the consequent production and pricing decisions of the firm. To the extent that negative externalities are present, an overproduction and overuse of environmentally hazardous chemicals will occur and an inefficient level of environmental quality will result (Mills and Graves, 1986).

FIGURE 6-1
SOURCES OF MARKET FAILURE

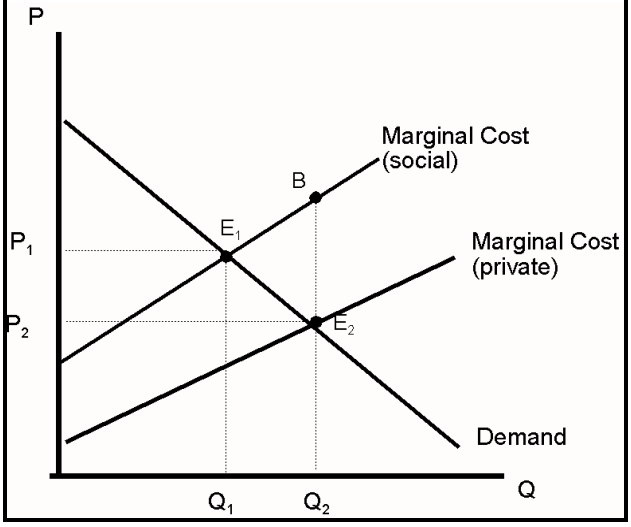


Figure 6-1 illustrates market failure in the case of external production costs. In the diagram, the marginal private cost curve is the firm's supply function. The demand curve represents society's willingness to pay. The private marginal cost curve differs from the social marginal cost curve by the dollar value of pollution damages (private costs + external costs). The intersection of marginal social cost and demand gives the socially optimal price (P_1) and quantity (Q_1). However, when pollution costs are not addressed, the equilibrium price is P_2 and the equilibrium quantity is Q_2.. For each unit consumed beyond Q_1, the distance between the marginal social cost curve and the marginal private cost curve represents the cost to society imposed by the externality. Society is compensated for a portion of these costs, because consumers willingness to pay exceeds marginal private costs. The remainder, area E_1E_2B is referred to as the deadweight loss. This is a cost in the sense that with external costs present, a lower-value combination of goods and environmental quality is produced than would otherwise be achieved.

TRI information from the final rule may facilitate constructive activities that internalize the negative externality by bringing the marginal social cost curve and the marginal private cost curves closer together. This outcome may be achieved by either reducing the marginal social cost associated with production of the good Q, and/or by increasing the marginal private cost. Marginal private costs may be increased, for example, by firms expenditures on pollution control.

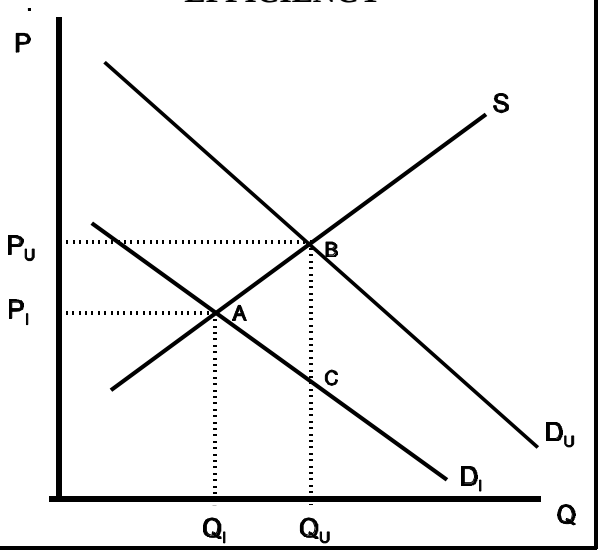
Marginal social costs may be decreased by changes in the production process, for example, by substituting less toxic alternative inputs for PBT chemicals.

The paradigm of negative externalities assumes that consumers are informed about the health and environmental effects of contaminants. However, it may be impossible to link specific health and environmental effects with particular point-source dischargers. Under circumstances when markets do not provide such information, the TRI provides valuable data that may facilitate a market-based solution as described above.[7] The next section addresses market failure when the consumer informational assumption is not met.

PBT Chemicals as an Asymmetric Information Problem

In economic theory, consumers and producers require complete information about all associated benefits and costs for resources to be efficiently allocated. Specifically, because of the nature of PBT chemicals, consumers may not have sufficient information regarding the health and environmental consequences of their purchasing decisions, and may or may not be aware of the limitations of the information they do have. This lack of information leads to inefficient market outcomes, a misallocation of resources, and diminished societal well-being.

FIGURE 6-2
INFORMATION PROVISION AND EFFICIENCY



Producers have a strong incentive to inform consumers of the positive aspects of their products in order to increase demand, but they do not ordinarily have an incentive to furnish consumers with information regarding the negative consequences associated with their products' use or production, such as the

[7] Economists have argued that it is theoretically possible for the firm to negotiate with members of the community about payments to compensate them for the damages they suffer, yielding an efficient distribution of resources even in the presence of externalities (Davis and Hulett, 1977). In his article *The Problem of Social Cost*, R. H. Coase suggests that public intervention is not necessary to correct market imperfections because the affected party may be able to pay the producer of the externality to reduce their activities which result in external costs or to implement pollution controls. Theoretically, the affected party would be willing to offer a "bribe" for incremental pollution reductions up to the point where marginal abatement costs and marginal damages are equal. Both parties would be better off up to this point because the incremental payments made by the affected party will not exceed their marginal damages (the affected party benefits) and the payments received by the firm will exceed their marginal costs of pollution abatement (the polluter benefits). A *socially* efficient level of production is achieved (the equity implications of this solution are not factored into this outcome). For the proper operation of the Coase Theorem, several conditions (which are generally unmet in cases of environmental pollution) must be present: 1) property rights must be well defined, enforceable, and transferable; and 2) transaction costs must be minimal in order to allow negotiation to occur (Field, 1994).

release of toxic chemicals to the environment. Lacking full information of the consequences of their purchases, consumers may over-value or under-value the goods in question. Generally, when consumers lack information regarding the negative consequences of their purchases, the result will be a misallocation of resources due to excess demand. The social cost or deadweight loss from *asymmetric information* is illustrated in Figure 6-2. In Figure 6-2, D_u represents the demand curve for Q when consumers are not fully informed. Similarly, D_i represents the demand curve for Q when consumers have all information relevant for purchasing decisions. The intersection between the market supply curve, S, and D_u and D_i determines the equilibrium price and quantities under each market setting, respectively. The equilibrium when consumers are uninformed is (P_u,Q_u), while the equilibrium for informed consumers is (P_i,Q_i). Uninformed consumers purchase greater amounts of Q at a higher equilibrium price as compared to informed consumers. As (P_i,Q_i) is the result that prevails in a properly operating market, the area ABC in Figure 6-2 is equal to the social cost.[8] Though this general description of the impact of consumers' lack of information is instructive, to properly assess the social benefits of the final rule, a further refinement in the characterization of the type of good being considered is required.

The type of good has a significant impact on the magnitude of the increase in efficiency resulting from government intervention to eliminate the information asymmetry. In an extension of Nelson (1970), Vining and Weimer (1988) and Boardman et al. (1996) describe three types of goods consumers may purchase. These goods are defined as 1) search goods - goods for which consumers can determine all relevant attributes before consumption; 2) experience goods - goods for which consumers can determine all relevant attributes only after consumption; and 3) post experience goods - goods for which consumers cannot determine all relevant characteristics immediately after consumption and may not become aware of all of these attributes for an indefinite period of time.

Asymmetric information characterizes the market for experience and post-experience goods.[9] For example, product repair frequency data for durable goods such as automobiles and large appliances constitute informational needs of consumers that may not reliably be met through primary market sources. Alternatively, consumers can accumulate information from secondary sources such as certification services, agents and subscription services.[10] Nelson (1970) defines

---

[8] In addition to imposing a less than economically efficient outcome on society, asymmetric information causes a redistribution of social welfare from consumers to producers. Under the assumption that uninformed consumers over estimate the quality of Q, Figure 6-2 illustrates this redistribution is equal to the area P_uP_i,A,B. While the transfer of social welfare does not reduce aggregate economic benefits, measuring such transfers may be useful for addressing other important values such as equity and distribution.

[9] Search goods are associated with a low probability of information asymmetry and represent markets where consumers are actively seeking to make purchases. To the extent that heterogeneity in quality is present, or the frequency of purchase is low, asymmetric information may exist. However, the potential for information asymmetry is expected to be minimal as producers have strong incentives to provide information (e.g. advertising) that mitigates voids in consumer knowledge.

[10] Vining and Weimer (1988) provide examples of certification services including professional associations and the Better Business Bureau. Subscription services include *Consumer Reports* as well as other similar publications. In addition, consumers may make inquiries with friends or relatives.

the use of secondary sources of information as "guided sampling" and provides statistical evidence that markets for secondary sources of information can function to provide relevant information for experience goods. These results suggest that government intervention in the market for experience goods is not generally required.

Unlike experience goods, the characteristics of post-experience goods remain unknown to the consumer indefinitely. In terms of Figure 6-2, this implies that deadweight losses, equal to the area ABC, occurs in every subsequent time period. In this situation a significant level of social costs will accrue.[11]

Vining and Weimer (1988) and Boardman et al. (1996) explain that markets for secondary sources of information related to post-experience goods fail to function effectively for several reasons. First, secondary sources may be unable to familiarize themselves with the characteristics of post-experience goods. Further, even though secondary sources may be able to collect relevant information, this process is likely to be very expensive.[12] Lastly, information has the characteristics of a "public good:" it is non-rival and non-excludable (depending on how it is made available). That is, once the information is gathered, one person's use of the information does not preclude another's use of the same information, and it is difficult to prevent uncontrolled distribution. Economic theory demonstrates that, absent some kind of collective action, the private market will fail to supply an economically efficient quantity of a public good (see the example in the box to the right). Vining and Weimer (1988) conclude that "...the strongest a priori rationale for public intervention on the grounds of information asymmetry arises in markets for post-experience goods (page 103)."

[11] Of course to accurately assess the total value of the deadweight losses over time, it is necessary to discount the value of these costs appropriately for all time periods beyond the initial period.

[12] This may especially true if negative attributes are of concern, as producers have little incentive to reveal this information.

Boardman et al. (1996) provides examples of potential post-experience goods, including adverse health effects from a prescription drug or employees exposure to toxic chemicals. However, exposure to toxic chemicals is not limited to employees, but includes society as a whole. The persistent and bioaccumulative nature of PBT chemicals places these chemicals in the category of post-experience goods. As discussed above, PBT chemicals may have large-scale health and environmental effects that are likely to remain unrecognized by relevant parties for an indefinite period of time. Because PBT chemicals are post-experience goods, the social costs that their health and environmental effects impose on society will accrue over time without appropriate information. For a number of reasons outlined above, secondary sources of information on PBT chemicals are unlikely to function effectively. Extensive use of the existing TRI demonstrates the important role that government plays in providing information on toxic chemical releases. The persistent and bioaccumulative nature of PBT chemicals and their appropriate characterization as post-experience goods suggests potentially significant social benefits from correcting market failure through the final rule.

Efficient Provision of a Good

In economic theory, production and consumption of a good is "efficient" only if the cost of supplying the good is less than the value placed on the good by consumers (that value is often measured by the amount that people are "willing-to-pay" (WTP) for the good). For example, if it costs $10 to produce a hammer, and person A is WTP $5 for a hammer while person B is WTP $15 for the hammer, then the efficient production level is one hammer (purchased by B). Likewise, if B were only WTP $8 for the hammer, then no hammers would be consumed in an efficient market. In both cases, the free operation of a market should provide the efficient outcome (i.e., only B purchases a hammer in the first case; nobody purchases a hammer in the second case).

With public goods, however, free markets don't lead to efficient results. Consider the case of a unit of information, which costs $10 to provide. Person A is WTP $5 for the information; person B is WTP $8 for the information. Because neither person is WTP $10 for the information, it will not be provided. Since, however, A's use of the information does not preclude B's use of the information, the value of that unit of information to society as a whole is the sum of the individual values; i.e., $13. Since society as a whole is WTP more than the production cost of the information, then it is economically efficient to produce it. In the case of public goods such as information, efficient allocation is possible only with some sort of collective action (such as persons A and B cooperating to purchase the information).

Information: an Approach to Correcting Market Failure

The discussion presented above demonstrates that there is a strong likelihood that significant market failures exist for PBT chemicals requiring government intervention. In the event of a significant market failure, public intervention is often required to achieve a more socially efficient outcome. Several alternative approaches are available to address market failure and to move society closer to an efficient allocation of resources: command-and-control (C&C) strategies, incentive-based strategies, and information-based strategies. C&C strategies tend to be less sensitive to differences in costs and benefits by setting standards for the quantities of pollutants a source may release. This approach is typically implemented by mandating specific control technologies (design standards) or specific environmental targets (performance standards). C&C strategies have been widely criticized on several grounds. By imposing a uniform standard across all facilities without consideration of the relative costs of emissions control, the standards

approach forgoes possible savings that could be achieved by reallocating emissions reductions among firms in such a way as to achieve the same overall reductions but at a lower cost.

In addition to their efficiency shortcomings, C&C strategies will sometimes discourage technological innovation or create a weaker incentive for innovation than the incentive-based approaches discussed below. In the case of a technology based standard, firms will tend to adopt the technology represented by the standard regardless of whether a better (i.e., less expensive or more effective) alternative exists in order to insure compliance. Also, in the case of a technology based standard, no incentive exists for research and development (R&D). When faced with a performance standard, the incentive for engaging in R&D equals any avoided compliance costs; however, this is a weaker incentive than is created by the incentive-based approach (Field, 1994). Thus far, the discussion has focused on the inefficiency of a uniform standard in achieving a specific emission level. This is a question of cost-effectiveness -- does the regulatory approach achieve a given emission level at least cost? In order to insure an efficient allocation of resources, however, emissions must not only be reduced at least cost but must also be reduced to a socially efficient level. Information such as total releases, marginal abatement costs, and human and environmental damages are required to estimate an efficient level of emissions.

Both the incentive-based approach and information-based strategies have advantages compared to the standards approach. Incentive-based strategies, rather than mandating a uniform standard across all generators, place a price on every unit of pollution creating an incentive for emitters to reduce their emissions. The most common approach is to set a charge per unit of pollution; however, other alternatives are also suggested in the literature, including tradeable discharge permits and abatement subsidies (Field, 1994). Incentive-based strategies may be able to reduce the same quantity of emissions at a lower cost compared to C&C strategies because an incentive is created for reductions to occur where it is least costly to do so. However, as with the standards approach, the regulating agency requires data in order to estimate the shapes of the aggregate marginal cost curve and the aggregate marginal benefit curve.

It is clear from the discussion above, that information such as that in the final rule plays a integral role in C & C strategies and incentive-based approaches to environmental management and policy. However, information itself can function as a market-oriented strategy for improving environmental quality. As in the case of incentive-based strategies, information-based strategies provide a more market-oriented alternative to C & C approaches. Specifically, they can lead to more cost-effective reductions in chemical emissions by allowing facilities the flexibility to decide whether and how to make reductions. Information-based approaches are quite varied: government testing and rating systems, mandatory disclosure requirements such as labeling and periodic reporting, and government provision of information. Consumers may respond to the additional information by changing their purchasing decisions (increasing or decreasing their consumption), by changing the way they use a product, or by altering their choice of where to live and work. Producers, who may previously be unaware of implications of their actions, will have the necessary information made available to them. In cases where the market is unlikely to provide adequate information, public intervention can provide consumers and possibly producers with information that will allow them to make better decisions.

6.2.2 POTENTIAL BENEFITS OF TRI INFORMATION BY USER GROUP

Social benefits from the final rule may accrue from activities observed across a broad spectrum of society. For example, environmental groups may use the data to gain more information about toxic emissions in their community, firms may find that increased information about emissions from their production processes suggests ways to improve efficiency and reduce costs, and state and local governments may use the data to respond to constituent inquiries at a lower cost. For purposes of this analysis, TRI data users are placed into three categories. This chapter examines ways the final rule might affect representative groups. Social benefits through "consumers" activities are discussed first, followed by benefits through industry and government groups.

Social Benefits Through Consumer Activities

The group of consumers includes, at a minimum, individuals or groups who would use the PBT chemical information that EPA is adding to the TRI. As evidenced by documented examples of TRI use, these groups include members of the financial and business community, academics and scientists, media, members of environmental organizations and the general public (MacLean, 1993; 1996). If publication of PBT chemical information leads to reductions in pollution, this generates "external" benefits. That is, benefits spill over to those members of the general public who may not be users of the TRI information. Therefore, consumer groups include those individuals that derive benefits from a clean environment, defined by the absence (or, relative reduction) of PBT chemicals in the environment. As defined, the consumers group is large, encompassing most if not all of society.

Financial and Business Community

Investors and lenders use TRI information along with other types of information to assess both publicly traded and privately held companies. TRI information may be used to incorporate the risks of major environmental liabilities, as evidence of good overall management, or to verify that business practices are in accordance with investor preferences.

Investors' use of TRI information is documented by a series of articles analyzing stock market reactions to the TRI public data releases. Two studies that examined the impact of new information provided to investors by the TRI suggest that polluting firms face potential losses in stock value (at least in the short term) principally when the TRI chemical reports were unanticipated. Hamilton (1995) found that firms whose large toxic releases were made public information by the TRI suffered at least a temporary drop in stock values. Investors may use the data to infer an evaluation of management rather than focusing attention on quantities in the TRI. Blacconiere and Patten (1994) found that firms whose annual reports disclosed pollution information prior to the TRI program were affected less by the TRI disclosures.

Academics and the Scientific Community

The academic and scientific communities have made extensive use of the TRI data. Their efforts represent a growing body of research that supports a greater understanding of the scientific behavior of TRI chemicals as well as the socioeconomic impacts of the provision of TRI information to other users discussed throughout this section. With such analyses, society can design and apply appropriate solutions to the market failures described above.

Media, Environmental Groups and the General Public

This category includes many users, and even non-users of the data, thus representing a broad spectrum of the general public. What these groups have in common is that they all derive benefits from health and environmental quality. Of course, environmental quality is an abstract concept, not an ordinary type of good or service traded in the marketplace. However, the demand for environmental quality influences the demands for many goods and services, including the demand for information about toxic releases. Informed consumers may satisfy their demands for environmental quality and be able to improve social well being.

Non-users of TRI chemical information can benefit as well if use of the data results in improvements in environmental quality. This is because, other things equal, people derive satisfaction from a clean environment, and environmental quality has characteristics of a public good (see Mayer, 1981; Rudd, 1983). This point is important because it means that the group of consumers who benefit from a clean environment is not limited to those who reveal a preference for a clean environment through direct or indirect action. In short, economic theory suggests that non-users of the TRI data stand to benefit from its provision, too.

Measuring potential social benefits to all consumers, including users and non-users of the TRI data, is complicated by the fact that we only have minimum (lower bound) data on the quantity of users. It is beyond the scope of this assessment to estimate the number of free riders, that is the non-users of the data, even though they benefit from the provision and use of TRI information. Few, if any, persons do not derive any value from a clean environment and thus, the number of free riders is expected to be large.

To the extent that evidence of the value of TRI data to the general public exists, analysis of media coverage may provide important insight. Assuming that news media respond to the interests of their audience, the extent to which journalists find the TRI data "newsworthy" and the factors that influence their coverage may indicate broad interest from the general public. Hamilton (1995) shows that news media find significant value from TRI data. Using information based on the first release of TRI data in June 1989, his analysis found that several important factors influenced whether firms received media coverage. Factors that increased the likelihood of media coverage included higher air emissions, land releases, underground injections, and waste shipped off-site. Importantly, the number of TRI reports submitted positively influence the probability of coverage. Thus, as with the case of investors, higher levels of emissions information available prior to the TRI data release had the effect of reducing the likelihood of

media coverage of the first TRI reports. Additional supporting evidence of social benefits from consumers use of TRI is provided below.

Social Benefits Through Industry Activities

Industry, specifically firms in SIC codes 20-39, have made extensive use of the TRI data. However, some of this use may be for purposes that, although beneficial from an individual firm's perspective, are not considered to be social benefits from an economic perspective. This analysis is limited to net social benefits arising from industry use of the TRI data. Under this framework, net benefits arise when the use of TRI information results in a reduction in the long run cost function and net savings to firms.[13] Cost savings might arise if the final rule provides new information to firms and firms respond in a way that reduces or recycles PBT chemicals, and cost savings offset any associated investments over a reasonable period of time. Cost savings here may reflect lower input costs, reduced waste treatment costs, and/or a reduction in the expected cost of environmental damage liabilities.

EPA's 33/50 program targeted 17 priority TRI chemicals for voluntary emissions reductions of 33 percent by 1992 and 50 percent by 1995 from 1988 reported levels. Arora and Cason (1995; 1996) provide evidence that some firms do reduce costs while reducing TRI emissions based on their analysis of EPA's 33/50 program. Underlying their analysis is the theoretical assumption that firms will not participate in a voluntary program unless it improves overall financial performance. These results suggest that firms can achieve significant reductions in toxic emissions while enhancing profitability through cost reductions.

Riley, Warren and Goidel (1994) published the results of a survey of firms that had reduced toxic emissions reported in the TRI. A key question addressed by their research was whether firms had changed production processes or whether changes in the level of production were responsible for TRI reductions. They found that changes in production process (source reduction) accounted for about 45 percent of the total reported TRI reductions. Although Riley, Warren and Goidel do not provide information on the costs of these reductions, it is worth noting that they were undertaken voluntarily. Only about 5 percent of TRI reductions were the result of overall decreases in output. Additional supporting evidence of net social benefits from industry use of TRI is provided below.

Social Benefits Through Government Activities

The final rule is designed to benefit society through reducing the cost and improving the quality of government decision making and policy development at all levels. States, localities, tribal governments and groups like the International Joint Commission (IJC) along with various programs in EPA use TRI data. Individual jurisdictions face high costs of collecting information. However, information collected nationwide through the final rule is expected to generate cost savings among jurisdictions attempting to collect such information.

[13] In particular, this framework excludes both intra- and inter-industry transfers from the calculation of net social benefits.

In addition, the final rule would provide social benefits through standardized reports that are made available to all governmental jurisdictions. Because PBT chemicals may be transported long distances without loss of toxicity the geographic scale of impacts may be regional or national. A state or locality may be affected by emissions sources from inside as well as outside their boundaries. However, their legal authority limits the amount of toxics release information that they can collect to that from within their individual jurisdictions. Only with a national standardized reporting framework can the entire scope of potential health and environmental impacts be examined and an economically efficient response designed.

Lastly, all levels of government may use the data to involve more stakeholders in the decision making process, reducing the probability of serious policy mistakes. Fiorino (1989) discusses the importance of integrating the "technical" model of risk assessment with the "democratic" model. He writes, "we cannot ignore the fact that technical values must be reconciled with democratic ones if we are to deal legitimately and effectively with environmental risk problems." Lynn and Kartez (1994) explain that the TRI promotes sound policy development by fostering dialogue among experts and the general public on how to most effectively control toxic emissions into the environment. To facilitate use, EPA has developed a geographic information system for locating TRI facilities in specific areas (Stockwell et al, 1993). Other examples of social benefits through government use of TRI data are presented below.

6.3 EVIDENCE OF TRI INFORMATION USE

6.3.1 GENERAL ASSESSMENTS

In order to demonstrate the value of TRI information, this section assesses the use of TRI data. This examination includes both general and more detailed assessments. TRI data use is analyzed according to the three types of users outlined in the theoretical framework, consumers, industry and government. The general assessments provide an overall indication of the percentage use of TRI data by the three types users. To the extent possible, the general assessment provides descriptions of each type of user's applications of the data. The detailed assessments provide more information about users of TRI data and are designed to augment the general assessments.

EPA Assessment

In developing this general assessment of the types of users of TRI data, EPA focused on three primary methods of access. The three primary methods of access include electronic access, use of data released on CD ROM and data reported in the annual TRI Public Data Release publications. For purposes of this analysis, consumers are defined as attorneys, consultants, educators, foreign public health professionals and organizations, interest groups, libraries, media, students and the general public. Industry includes both regulated and non-regulated firms. Finally, government includes federal and state governments as well as local government jurisdictions.

Electronic Access Routes

Electronic access to TRI data is becoming increasingly common. Since the data became available on-line there has been considerable growth in the number of Internet TRI data searches.[14] Internet access is provided through a number of web sites including the Right-to-Know Network (RTK NET), the National Library of Medicine's Toxicology Data Network (TOXNET), as well as EPA's Envirofacts Warehouse Query web page.

Non-Electronic Access Routes

CD-ROMs

Beginning in 1989 and every year thereafter, EPA has published a CD-ROM containing the Toxics Release Inventory (TRI) data. EPA's Office of Pollution Prevention and Toxics (OPPTS) publishes the entire TRI database from its inception in 1987 through the current reporting year on two compact disks, in a format that allows easy searches. OPPTS distributes the CDs to libraries all over the country, to make TRI information widely available for public use.

Currently, EPA distributes over 4,000 CD-ROMs, including distribution to libraries and public interest groups per year. To make TRI information widely available for public use, the CDs are distributed free of charge to non-profit organizations, educators, government agencies and the general public upon request. These groups may obtain free copies by calling the National Center for Environmental Publications and Information (NCEPI), EPA's Toxic Release User Support Service (TRI-US) or headquarters personnel. In addition, a number of CDs are provided to each EPA regional office so that they may facilitate free distribution of TRI data. EPA also provides CDs to each of the 50 states and the U.S. territories. The U.S. Government Printing Office (GPO) provides free copies of the CD to federal depository libraries. Finally, industry can purchase the CDs from either the National Technical Information Service (NTIS) or GPO.

EPA's Distribution of Toxics Release Inventory Public Data Release

Beginning in 1989 and every year thereafter, the Environmental Protection Agency (EPA) has published an annual report entitled "Toxics Release Inventory: Public Data Release."[15] The report also contains general data for a limited number of earlier reporting years as well as the baseline year. EPA makes the Public Data Release available through direct mailings from headquarters. Among those included in this direct mailing are federal state agencies, environmental organizations, labor organizations, EPA personnel and regional offices, state TRI coordinators and tribal organizations.

[14] Estimates presented below do not account for searches conducted on web sites individual states or other organizations maintain.

[15] TRI data was formerly published in a report entitled "Toxics in the Community."

Other Access Routes for TRI Data

In addition to the three means of access discussed above, there are several other ways to obtain to the TRI data. Individuals may acquire TRI data and other supporting materials from TRI-US, the Emergency Planning and Community Right to Know Act Hotline (EPCRA), EPA's Regional offices and NCEPI. NCEPI is also a source for copies of State Fact Sheets. Because of difficulty in gathering the underlying data and the resulting inability to properly distribute it among the three TRI data user types, these sources of TRI data are not included in the estimates presented below.

Table 6-2 shows TRI data use via the three access routes examined in this analysis. For each type of access route, use is summarized by the three categories of consumers, industry and government. As shown in Table 6-2, consumers clearly represent the largest category of data users, especially for electronic access routes.

TABLE 6-2
TRI USER TYPES AS A PERCENTAGE OF USERS BASED ON THE THREE PRIMARY ACCESS ROUTES

Access Routes	Consumers	Industry	Government
All Access Routes	57%	29%	14%
Electronic Access Routes	58%	31%	11%
Non-Electronic Access Routes	45%	11%	44%

Notes: Percentages presented in this table are rounded off to the nearest percentage point.
Non-electronic Access Routes includes CD ROM and Public Data Release distribution.

To further support EPA's overall assessment, a bibliographic data set including about 500 entries to assess the number and types of analyses, papers, reports, and public outreach materials that use the TRI as a data source has been compiled. The citations in the data set include documents prepared by public agencies, university researchers, public interest groups, trade associations, and private industry, as well as media reports. Table 6-3 summarizes the data set, listing, for each user type, the number of documents identified by categories of TRI data use.

TABLE 6-3
SUMMARY STATISTICS OF BIBLIOGRAPHY DATABASE

Document Type	TRI Use						
	Outreach	Analysis of TRI Data				Regulatory	Total
		Trends	Environmental Justice	Comparison	Other*		
Federal	33	1	2	1	24	8	69
State/Local	132	0	2	2	19	6	161
Public interest groups	51	11	7	7	66	16	158
Journal	10	8	6	1	19	2	45
Trade/business	18	14	0	0	23	1	56
Media	30	2	0	0	1	0	34
Total	274	36	17	11	152	33	523

*Other includes other research topics and local risk assessments.

As shown in Table 6-3, federal and state and local agencies generate the largest share of reports and materials that use the TRI data. The second largest share of documents in the bibliography database comes from public interest groups. Finally, two categories that appear to have fewer publications, industry and the media, most likely generate many publications that have not been counted.

Evidence of Use from a Mail Survey

Lynn and Kartez (1994) conducted a mail survey of active TRI users, including 112 public interest organizations, 55 state and territorial agencies that coordinate Section 313 activities, and 35 firms recommended by the Chemical Manufacturers Association. Survey respondents (71%, including 67 public interest organizations, 44 state agencies, and 19 industry representatives) indicated whether a variety of data availability formats were “most” and “least” useful to them as ways to access TRI data. This study predated the popularization of CD ROM and Internet access to TRI data.

Of particular interest is that all three groups agree that other reports that include TRI data are most useful. Lynn and Kartez suggest that these “secondary” materials are useful because they place the TRI information into a meaningful context that makes it easier to understand; e.g., they might frame an issue such as stratospheric ozone depletion and show, using TRI data, how local industries contribute to the problem.

Respondents also provided information about how they used the data (see Table 6-4). The largest use categories for citizen groups were exerting public pressure on facilities and educating affected residents. Other important use categories for this user group pertain to regulatory assessments and recommendations. The most important use of TRI data for states is to check emissions with permit records. Interestingly, state agencies were less likely to use TRI data for regulatory assessments and recommendations than citizen groups. The most frequent industry uses of TRI data were identifying source reduction opportunities, conducting outreach activities, and comparing their emissions to similar facilities. As in EPA's general assessment, these results are consistent with consumers and industry use of the TRI data that will result in the success of information-based, market-oriented approaches to environmental protection.

TABLE 6-4
USES OF TRI DATA

Use	Percent Reporting Use		
	Citizen Groups	State 313 Agencies	Industry
Check emissions against permit records	36	64	32
Compare emissions to similar facilities	46	41	42
Fund raising	22	5	0
Prepare court litigation	15	7	0
Exert public pressure on facilities	85	27	5
Lobby for legislative or regulatory change	75	14	16
Prepare recommendations for legislative/regulation	57	34	16
Emergency planning	13	36	32
Educate affected residents	79	16	53
Identify needs/opportunities for source reduction	51	48	58
Direct citizen/industry negotiations	45	11	11
Prepare company profile(s)	34	18	53
Assess adequacy of current laws	52	30	16

Source: Lynn and Kartez, 1994

6.3.2 DETAILED ASSESSMENTS BY USER TYPE

Consumers' Use of TRI Data

As shown in Table 6-2, consumers represent the largest group of TRI data users. Consumers use electronic access (e.g. Internet) more than other means of accessing TRI data placing relatively less reliance on non-electronic access. Specific uses of the TRI data by various groups of consumers are examined in greater detail below.

Use of the Data by Community and Public Interest Groups

Communities use TRI data to begin dialogues with local facilities and to encourage them to reduce their emissions, develop pollution prevention plans, and improve safety measures. Public interest groups use the data to educate the public about toxic chemical emissions and potential risk.

- Interest groups seem to find RTK NET useful as their principal interest is often in retrieving particular facts about emissions at specific facilities (MacLean 1996, 1993)

- A bibliography prepared by the Working Group on Community Right-to-Know in the summer of 1994 lists well over 100 state and local reports and more than 30 national TRI reports compiled by public interest groups (Orum and Wohlberg, 1994).

- "Manufacturing Pollution", a report produced by Citizen's Fund in August 1992, aggregated 1990 TRI data from different facilities by their parent company, in order to hold corporations more accountable for the full extent of their toxic pollution. The report summarized releases of all TRI chemicals, as well as subsets of chemicals that could cause cancer or birth defects (Citizens Fund, 1992).

- "Poisons in Our Neighborhoods", a report produced by Citizen's Fund in November of 1993, summarized 1991 TRI data nationally and by state. The report attempted to measure the progress of manufacturers in preventing pollution and included report cards evaluating the pollution prevention efforts and performance of the top 50 waste generating facilities in the chemical industry (Citizens Fund, 1993).

- "Troubled Waters: Major Sources of Toxic Water Pollution", a report released by the U.S. Public Interest Research Group in June 1993, examined TRI releases to surface waters and to publicly-owned sewage treatment plants and identified the nation's top releasers of toxics to those water sources. The report made recommendations for amending the Clean Water Act to provide the public more information about toxic releases to waterways and to strengthen enforcement (Hartmann, 1993).

- "Where the Wastes Are", a report released by OMB Watch and the Unison Institute in April 1994, examines facilities receiving the largest quantities of shipments of TRI chemicals in waste. The report identifies the largest off-site recipients overall and in particular categories, such as incinerators and landfills. The report also profiles certain companies active in the operation of these toxic waste management facilities (MacLean and Puchalsky, 1994).

- The Georgia Environmental Policy Institute provided TRI data to a family in southwest Georgia who needed information about toxic releases from a nearby plant to assist their doctor in determining the need for medical testing. Following an incident and evacuation, this same group also provided TRI data to a citizen who inquired about toxic releases from a plant located next to a school (McLure, 1994).

- Following the release of an environmental group's report identifying a local facility as the 45th-largest emitter of carcinogens to air in the nation, community activists in Northfield, Minnesota worked with the Amalgamated Clothing and Textile Workers Union to call for emissions reductions. Contract negotiations between the union and the facility resulted in an agreement for a 64% reduction in the use of toxic chemicals by 1992, and a 90% reduction in toxic emissions by 1993 (Settina and Orum, 1991).

- In 1993, the Minnesota Citizens for a Better Environment released a report profiling the state's "top 40 toxic polluters" based on emissions of certain priority chemicals. In addition to TRI data, the report provided other information such as: the facilities' compliance histories; maps of major streets, schools, health care facilities, and water bodies in the area; information about local populations; contact information for facility representatives, government representatives, civic associations, and other organizations; and toxicity information. The report was designed to provide enough information to support local efforts to negotiate with facilities for emissions reductions. Since publication, activists have worked with 18 of the 40 facilities identified in the report (Doer, 1995).

- After TRI data identified Syntex Chemicals in Boulder as a top Colorado polluter, extensive publicity led to negotiations between local activists and the facility concerning emissions reductions. After a lengthy process that involved the facility's corporate headquarters, the facility signed a good neighbor pledge to reduce its air toxics emissions 50% by 1994 from 1989 levels. The facility also agreed to set up a community advisory panel to facilitate communications between the facility and the community (Settina and Orum, 1991).

- In March 1993, the Texas Network for Environmental and Economic Justice published a report entitled "Toxics in Texas and Their Impact on Communities of Color". This report used TRI and other data to document disproportionate environmental impacts on racial and ethnic minority communities in Texas. The report includes case studies, maps, relevant legal and institutional information, and recommendations (Texas Network for Environmental and Economic Justice, 1993).

- The Environmental Working Group (EWG) used TRI data to compile national water pollution data (Savitz et al., 1996b), and recently used TRI on transfers to track the use of toxic waste in agricultural fertilizer manufacture (Savitz et al.,

1998). The study found that 454 farms and fertilizer manufacturers received 271 million pounds of toxic waste between 1990 and 1995 from facilities such as steel mills and electronic component manufacturers. The wastes included lead, cadmium, solvents and industrial chemicals; the carcinogenic chemicals accounted for 13.9 million pounds. Facilities in California, Nebraska, and New Jersey received the most waste. A forthcoming study uses TRI data to identify the volume of toxic air pollutants released in proximity to schools in California (B. Walker, EWG, personal communication, 1998).

- The Oneida Environmental Resources Board used TRI data to convince Oneida Tribal leaders to organize a conference called Clean Paper Making Techniques for the 21st Century. The data showed that the pulp and paper industry was the largest industrial source of toxic releases in Wisconsin despite industry claims that large past successes meant further improvements were not necessary (Manthe, 1997). They also used TRI data to alert a local labor union about possible worker health risks. The union was able to include requests for emissions reductions as part of the contract renewal process.

- Centner et al. (1996) discuss the burden of proof that must be met by community groups when pursuing an environmental justice lawsuit, and how TRI data and such statistical analyses may help those groups meet their burden. The authors use TRI data and three separate models to analyze the influence of race, income, political organization, and industrial-location factors on neighborhood exposure to toxic releases from manufacturing facilities in Georgia and Ohio. While a tobit-regression model involving three discriminatory factors support the position that the differential pollutant exposure is due to differences in both race and income, a more complex industrial-location tobit-regression model considering nondiscriminatory factors suggests that race is not significant.

- In 1996-1997, Arizona Toxics Information developed an integrated toxics data management system for land-use planners and emergency planners in the neighboring towns of Naco, Arizona, and Naco, Sonora, Mexico (Gregory, 1997).

Several organizations are developing websites that combine TRI data with GIS mapping technologies and toxicity information to provide value-added information about toxic releases to the public outreach materials. These sources play an important role in disseminating TRI data because they provide a meaningful context. Examples include the following:

- The Environmental Defense Fund recently unveiled its Scorecard Internet site (www.scorecard.org). At this interactive website, an individual can obtain TRI-based pollution load and health hazard rankings for 17,000 facilities, 5,000 ZIP code areas, and 2,000 counties (EDF, 1998b). After the site was widely announced, April 15, 1998, the access rate was close to 40 requests per second, “making it one of the Internet’s most heavily accessed purely db-backed sites.”

(EDF, 1998a). The site also has a feature that lets the user send free faxes to facility and agency officials.

- The Children's Health Environmental Coalition is developing a website (www.checnet.org) that provides a variety of information on children's health issues, including a "Toxic Hot Spots" page that will provide users with an inventory of toxic releases by location as well as supplementary information on health effects, and product content information (Schubert, 1997).

- MapCruzin combines GIS technology with TRI data to let Santa Cruz residents and Silicon Valley residents find the exact location of businesses in their areas that report transfers and releases (http://www.mapcruzin.com/svtc_maps/index.html; http://www.mapcruzin.com/scruztri/index.html)

Use of the Data by Education and Research Institutions

The TRI data are being used in many environmental education programs, particularly at the high school and university levels. Students learn about toxic chemical releases, the potential health and environmental effects of those releases, pollution prevention activities and opportunities, and the social and political aspects of environmental protection. Some organizations also are conducting educational outreach programs using TRI data. For example:

- Beginning in September 1998 the TRI CD-ROM will be made available to high schools. Through a grant with the National Science Teachers Association the TRI CD ROM will be used to highlight the TRI database as the centerpiece in a cross-disciplinary set of classroom materials and activities (National Science Teachers Association, 1998).

- Brooks and Sethi (1997) use TRI data to examine the relationship between community-level exposure to air toxics and the socioeconomic, political, and demographic characteristics of the population.

- Students in the Environmental Studies Department at Dickinson College (Pennsylvania) use TRI data to conduct toxic waste audits on communities or facilities. Students identify epidemiological and environmental health effects, occupational exposure standards, and other relevant information. Students arrange plant tours which focus on toxic chemical use reduction and "good neighbor" agreements between facilities and communities. Students also meet with local citizens, environmental organizations, labor unions and others ("Notes From the Field," 1992).

- The John Snow Institute Center for Environmental Health Studies has developed a tutorial entitled "Environment and Health: How to Investigate Community Environmental Health Problems". This tutorial introduces the public to the TRI and other resources which can be used to identify and address local pollution

sources. Audiences include librarians, local officials, members of the media, environmental advocates, the general public, and students from high school to graduate level (Greene, 1995).

- Researchers at the University of California, Santa Barbara's Center for Geographic Information and Analysis used 1989 TRI data and 1990 U.S. Census data to examine and map significant relationships between the race and income of populations and their proximity to TRI sites in Los Angeles (Burke, 1993).

Use of the Data by the Financial and Business Communities

Increasingly, TRI data are being used in financial decision-making. Investment analysts use TRI data to provide recommendations to clients seeking to make environmentally sound investments. Insurance companies look to TRI data as one indication of potential environmental liabilities. Consultants and others use the data to identify business opportunities, such as marketing pollution prevention and control technologies to TRI reporting facilities. Demand for environmental performance information by investors, insurance companies, and the public has led many companies to develop environmental annual reports similar to annual reports on financial performance traditionally prepared for investors.

- Blacconiere and Patten (1994) studied the market value of securities of 47 firms that reported chemical use in the TRI. They found that firms whose annual reports disclosed pollution information prior to the TRI program were affected less by the TRI disclosures.

- The Clean Yield Group, an investment portfolio management group, compares companies' TRI release data to their industry averages of pounds of toxic chemicals per dollars of sales. This serves as a rough yardstick to gauge how the company measures up against other companies in its industry, and allows the investment firm to track how the company's release performance is improving from year to year (Hausman, 1993).

- A leading popular business magazine used TRI data as a central element in compiling a "green index" of America's biggest manufacturers. The magazine examined companies' environmental records and developed a relative ranking system that assigned companies scores from zero to 10 in 20 different performance categories, including the amount of toxic emissions per dollar value of sales, and their percent reduction in toxic chemical emissions. The article included lists of 10 leading companies, 10 "laggard" companies, and 10 most improved companies (Rice, 1993).

- Hamilton (1995) examined whether investors responded to EPA’s release of TRI data in June, 1989. Investors found TRI information useful because many of the companies with large toxic releases were also publicly traded, and release information sends signals about the cost of future liabilities resulting from pollution

cases, the costs associated with regulatory compliance, and consumer reactions to polluting companies.

- Neuberger & Berman, LLC has a Socially Responsive Investment Group that screens the companies in its investment portfolio based on social criteria — provided the companies first meet a financial performance criterion. The portfolio managers use the TRI to evaluate whether a company has a good environmental performance record, and whether it has demonstrated a commitment to reducing emissions. To evaluate performance, they use TRI data to compare a company's releases with industry-wide trends and with the company's own historical releases (Saukaitis, 1997).

- The Investor Responsibility Research Center (IRRC) has an Emissions Efficiency Index®, which is based on TRI data, that indicates which companies have a competitive edge in environmental performance. The index is predicated on the idea that higher emissions are associated with higher risks of negative publicity, tort actions, and increasing costs for pollution control and waste management. IRRC's constituency uses TRI-based information to identify companies with poor environmental records. Investors will then either screen such companies out of their portfolios or purchase shares and use their ownership as leverage to improve environmental performance (Haldeman, 1997).

Industry Use of TRI Data

As shown in Table 6-2, electronic access (e.g. Internet) appears to be the most important means industry employs in accessing TRI data. Industry places relatively less reliance on non-electronic access routes. Specific uses of the TRI data by various industry groups are examined in greater detail below.

- Wolf (1996) looks at the performance of the TRI program, and its observed impacts on regulatory agencies, public interest groups, the regulated community, and legislatures. The regulated community is one of the largest users of the TRI database. Major corporations are increasingly issuing environmental progress reports, to counter adverse publicity that might be caused by their annual TRI report, and establishing future pollution prevention milestone targets in those reports.

- Pine (1997) provides some examples of how TRI information has helped companies develop waste reduction strategies. For example, Marathon Oil installed a thermal desorption unit to process oily wastes and recovered over 120,000 barrels of oil; Georgia Gulf Corporation relocated a methanol stripper purge line that resulted in recovery of 9,300 gallons of methanol that previously underwent biological waste treatment.

- Eli Lilly and Company invested over $500,000 in an effort to improve the quality of its materials balance calculations that identify waste stream contents and sources. The firm made the investment because it believes that improving the TRI data collection process also improves its understanding of the production process, which can help identify pollution prevention options and make production more efficient (Lattimer, 1997).

- Attendees at a 1997 TRI workshop in EPA's Region III provided reasons for undertaking waste reduction activities. Cost reduction was the reason given most frequently (98% of respondents) (Reilly, 1997).

- Bagby et al. (1995) discuss the benefits of broadly disseminated environmental pollution information, through such reporting programs as TRI, CERCLA, and securities disclosure requirements. Benefits can accrue to both environmentally responsible companies and individuals. For example, without accurate information on environmental liabilities of individual firms, financial markets tend to discount stock prices of entire industry groups suspected to be facing uncertain future cleanup and abatement costs. Firm-specific disclosures have the benefit of informing investors about companies with significant environmental problems without punishing those firms with a responsible environmental record.

- Konar and Cohen (1997) examined whether firms alter their behavior in response to a significant drop in stock market value resulting from the release of new TRI data. The authors identified all firms whose stock dropped upon the announcement of their TRI emissions in 1989. Those firms were found to fall among the top 1/3 of polluting firms (as measured by TRI emissions per dollar revenue) but not to be the largest overall emitters of TRI chemicals. In response to the drop in stock market value, these firms subsequently reduced their TRI emissions by more than other firms within their industry and sought to improve their environmental record in other areas. The authors conclude that the release of new and unexpected TRI data, such that there is a substantial change in the stock market value of the firm, can induce a firm to improve their environmental record, including by reducing TRI emissions.

- Arora and Cason (1995; 1996) use TRI data in analyzing firms' participation in EPA's 33/50 program. These papers examine the potential for voluntary programs to achieve improvements in environmental quality.

The public availability of the TRI data has led many corporations to publicly commit to voluntary emission reductions. The first of these pledges was Monsanto's 1989 commitment to reduce its worldwide air emissions of toxic chemicals by 90% by 1992. Many other companies, including AT&T, Dow Chemical, Dupont, Merck, and 3M, soon followed with their own reductions goals (MacLean and Orum, 1992). In addition to providing the impetus for these reductions pledges, the TRI data also provide the public with the measurement tool needed to

track companies' progress, as well as providing the companies a means of demonstrating their commitment and success.

As another example, the Iowa Association of Business and Industry coordinates a community-wide pollution prevention initiative in the Des Moines-Polk County area. The group has adopted goals of a 60% reduction of all TRI chemicals by 1992 and a 70% reduction by 1995 (U.S. EPA, 1993).

Government Use of TRI Data

As shown in Table 6-2, government constitutes the smallest group of TRI data users representing only 14% of total access. However, government officials appear to place relatively greater reliance on non-electronic access than does industry and uses non-electronic access routes about as frequently as do consumers. Specific uses of the TRI data by various government organizations are examined in greater detail below.

Use of the Data by EPA

Many offices within EPA use the TRI data and taken together account for a large portion of governments' use of the data. This section details use by some of these offices.

Use of the Data by the Office of Pollution Prevention and Toxics

EPA's 33/50 Program targeted 17 priority TRI chemicals for voluntary emissions reductions from 1988 reported levels of 33% by 1992 and 50% by 1995. More than 1200 companies nationwide joined this program. The program provided recognition to participating companies, including Certificates of Appreciation to all companies upon enrollment, as well as Certificates of Environmental Achievement to a select group of facilities that have achieved noteworthy reductions. The program reached its interim 33% reduction goal one year early, and reductions by 1994 already totaled 50%.

The Office of Pollution Prevention and Toxics' Existing Chemicals Program continues to use the TRI data for risk screening, determining testing needs and priorities, and considering and developing pollution prevention activities. TRI data serve as a major input to exposure and risk assessments in OPPTS. The TRI is especially important to OPPTS's initiatives on pollution prevention. TRI data are used for targeting chemicals, uses, and facilities for pollution prevention assessment and for evaluating pollution prevention actions. TRI data are also used in OPPTS outreach efforts in responding to inquiries from a variety of sources.

OPPTS's Environmental Assistance Division (EAD) has developed software that contains health and ecotoxicity information on most of the section 313 chemicals. This software, called PC-TRIFACTS, enables the TRI data user to better understand the potential health and ecological effects of chemical activities identified in the TRI. TRIFACTS was made available in January, 1991, to a wide audience of TRI data users, and has had a very positive response.

From 1989 to 1991, OPPTS has prepared annual reports that summarize and compare current and historical TRI data. Beginning in 1992, the TRI data are presented through annual comprehensive data releases. Also, EAD develops two summary reports to distribute to the public at the time the complete national TRI database is released. One report summarizes the national TRI data, while another report provides more detailed information on a state-by-state basis. These reports help raise public awareness of the TRI data and provide ready access to aggregate information that facilitates tracking of national, state, and industry progress in reducing emissions. Many states prepare similar summary reports for their TRI data each year.

OPPTS's Pollution Prevention Division (PPD) has used TRI data as a screening tool to prioritize proposed regulations and industrial source categories to promote pollution prevention in rulemaking. As a result, the Pollution Prevention Senior Policy Council has identified a number of regulatory development efforts that should consider inclusion of pollution prevention measures.

OPPTS is developing a Risk-Screening Environmental Indicators model that permits screening-level analyses of the potential risk-related impacts of reported TRI releases. The Risk-Screening Environmental Indicators supplement a quantity-based ("pounds only") view of releases by incorporating information and models that assess, at a screening-level the risk-related trends that chemical releases may pose. The information and models enable one to consider the toxicity of chemicals, the quantity to which people are exposed and the size of the population exposed to those chemicals.

Use of the Data by the Office of Air and Radiation

The Office of Air and Radiation (OAR) has used the TRI data for a variety of tasks related to the implementation of the Clean Air Act Amendments of 1990 (CAAA). Title III of the CAAA requires EPA to develop Maximum Achievable Control Technology (MACT) standards for major sources of 189 hazardous air pollutants, all but 8 of which were on the TRI list of toxic chemicals prior to EPA's expansion of the EPCRA section 313 list of toxic chemicals. TRI was used to estimate the number of major sources (greater than 10 tons per year of any single hazardous air pollutant or 25 tons per year of total toxics) of hazardous air pollutants in each of 700 source categories. This information helped to prioritize the source categories for regulatory development. In addition, the impacts of a potential lower major source definition for 47 highly toxic compounds were analyzed using TRI data.

TRI was used to help identify the 30 hazardous air pollutants to be included in the Urban Area Source Program mandated by section 112(k) of the CAAA. OAR also has used TRI to expand the coverage of the "Locating and Estimating" series of documents, which help State and local air agencies identify potential source categories of air toxics in their communities. Similar data have been incorporated into the Crosswalk database, which identifies which source categories emit which toxic compounds. OAR is developing a series of air quality indicators to track progress in implementing the CAAA. Trends in the TRI data are envisioned to be a part of those indicators.

Use of the Data in Enforcement Activities

The Office of Enforcement and Compliance Assurance (OECA), and EPA Regions continue to use TRI data as a tool in inspection targeting and enforcement. TRI data are constantly evaluated with an eye towards sector-wide EPCRA initiatives. The data are included in a new enforcement database system which is being used to develop and implement multi-media/multi-statute cases and initiatives.

OECA cross-checks data collected under EPCRA and other environmental statutes to identify those facilities or types of businesses which reported for some but not all of the reporting rules. Enforcement personnel are able to identify additional facilities owned by the same corporation or by the same parent company that may be subject to liability, by using TRI data and the Facility and Company Tracking System (FACTS).

OECA uses the TRI data in its EPCRA Targeting System (ETS), which provides local access to TRI and FACTS data for all facilities subject to EPCRA section 313 requirements. ETS supports creation of prioritized inspection targeting lists, generated from a wide array of selection criteria, and daily targeting activities such as contacts with facilities and tracking tips and complaints. Currently, nine out of ten Regional field offices have been introduced to this new system.

OECA also uses TRI data in the Integrated Data for Enforcement Analysis (IDEA) System. IDEA provides integrated data on individual facilities' compliance records for most of the statutes administered by EPA through access to approximately ten separate databases, including the Toxics Release Inventory System (TRIS). The TRI data aid OECA in developing enforcement initiatives by providing a point of departure for distinguishing between industrial sectors based on their potential for exceeding permits as indicated by the amounts of chemicals reported as managed in waste.

TRI data continue to be extremely helpful in identifying pollution prevention projects. Enforcement staff use data on releases and transfers to identify (or evaluate) projects that will significantly reduce emissions, or those that will help prevent or minimize the release of extremely hazardous substances under EPCRA section 302.

OECA places a high priority on enhancing the use of TRI data among Regional field personnel. Additional guidance was provided to the field offices on the resources available to their inspectors in identifying non-reporters, late reporters and data quality errors. These resources provide the inspectors with valuable information extrapolated from the TRI, such as facility reporting rates, processes, and releases.

Use of the Data by the Office of Solid Waste and Emergency Response

TRI data may assist in priority setting for waste minimization efforts by the Office of Solid Waste and Emergency Response (OSWER). In combination with other information OSWER collects on waste minimization, TRI data are useful in analyzing long-term trends and identifying

particular industry practices that warrant attention by the program, serving OSWER pollution prevention goals.

With respect to enforcement, TRI data supplement other existing data sources and can be called on to assist in the development of OSWER enforcement priorities. TRI data also are valuable as a means to assist in establishing liability under both the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Resource Conservation Recovery Act of 1976 (RCRA) statutory authorities.

Another site-specific function of the TRI database relates to its role in providing emission information that can be used when developing emission inventories for the Superfund site discovery program and when undertaking Superfund preliminary assessments of sites. In the reportable quantity (RQ) program, TRI data could be used in analysis to support future rulemaking under CERCLA (e.g., designation of additional hazardous substances).

Use of the Data by the Office of Water

The Office of Water (OW) has used TRI data for identifying candidates for the National Primary Drinking Water Regulations. Chemicals were identified that had a dramatic overall increase (doubling or more) of discharges and releases. These discharges and releases were considered to have direct potential for drinking water contamination.

TRI data are commonly used by states as a screening mechanism for possible sources of wellhead contamination. By using TRI and other relevant data in a Geographic Information System (GIS), states can identify potential contamination sources. It is important to identify these sources in the development and implementation of wellhead protection programs. In addition, EPA is encouraging states to use TRI data as they conduct the new source water assessments for the drinking water supplies in their state. Regions are continuing to coordinate ground-water programs, using GIS and TRI and other relevant Agency data as a cross-program tool.

OW is also using the TRI data in development and implementation of management plans to identify the sources of toxic discharges into selected estuaries and coastal waters. In addition, the data are being used to identify sources of toxic discharges that may contaminate sediments that are proposed for ocean dumping.

Under the Watershed Protection Approach, the Regions are using TRI data along with other data in assessing loadings to their watersheds. They are identifying multi-media sources of toxic discharges to receiving waters.

The Office of Water Enforcement and Compliance (OWEC) used TRI to identify industrial users with the greatest contribution of toxic pollutants to city sewer systems. The industries were identified and facility names were provided to the Regions for further evaluation.

OWEC used TRI data to identify industrial users subject to pretreatment standards that are located in cities which are not required to have pretreatment programs. Further work will

compare location of users to cities without approved pretreatment programs and may be a way of identifying industrial users for which EPA has regulatory responsibility. The data also were used in compiling the Report to Congress on the National Pretreatment Program. The data and analysis were used to examine what the next steps of the national pretreatment program should be. TRI data were used in providing a broad picture of the types and sources of pollutants discharged to POTWs, and in setting priorities.

OW used TRI data as one of several sources of information in developing regulations under section 316(b) regarding cooling water. The TRI data were useful in identifying facilities to include in a nationwide list of facilities (aka “sample frame”) within several major industrial groups. The list was used to select a random sample for survey.

OW used TRI data to understand which pollutants are released from pesticide manufacturing facilities and the pattern of releases when developing effluent limitations guidelines and standards for an industrial category. OW also used TRI data and other water emissions data in its National Sediment Contaminant Source Inventory, an evaluation of sources of sediment contamination in the U.S. This project identified point source pollutant discharges that may result in sediment contamination and analyzed these releases based on their potential sediment hazard. Chemical release amounts were weighted by the relative toxicity of a compound to aquatic or human health, as well as relevant fate and transport factors. The study identified chemicals, geographic areas, and industrial categories of greatest concern for sediment contamination.

Use of the Data by Other EPA Offices and Regions

Three EPA Regional offices are developing a screening process that will allow decision-makers to focus pollution prevention efforts, exposure and risk assessments, or epidemiological studies on areas of greatest concern. The first phase of the process produces a "Chronic Index" which ranks TRI releases in terms of their relative toxicity. The results of this Index are aggregated by facility, by chemical, and by geographic area using a grid system. The second phase of the process, now under development, will produce a "Vulnerability Index", which describes the susceptibility of populations by scoring demographic attributes such as age, economic status, and minority status.

Researchers from EPA's Office of Health Research recently published a study of national and regional differences in county-level TRI air emissions according to the ethnicity or race and household income of the populations. Using a measure known as a "Population Emissions Index", a population-weighted average emission for each county, the study found that all minority groups except Native Americans tend to live in counties where TRI air emissions levels are higher than they are in counties where non-minorities live. However, the data also suggest that household incomes tend to be higher in counties with higher TRI air releases.

EPA's Office of Information Resources Management sponsored the development of a Population Estimation and Characterization Tool, which uses GIS technology and demographic data for risk-based and environmental justice applications. The tool allows users to estimate and

characterize populations within a given radius of a single TRI facility or multiple facilities and to identify areas of multiple potential exposure.

EPA's Office of Research and Development and Office of Enforcement and Compliance Assurance are developing a "Multi-Media Ranking System" to prioritize sites for enforcement actions and to evaluate the effectiveness of environmental laws in reducing risks from sites. The system ranks sites based on their multi-media releases of pollutants, their potential risk to human health and the environment, and the history of legal violations by the facility. The system combines TRI data with data from EPA air and water databases. For each site, the system develops a Chemical Ranking Factor based on chemical toxicity and fate information, a Vulnerability Ranking Factor based on the climate, soil type, and other environmental properties surrounding the site, and a Population Ranking Factor based on the demographic characteristics surrounding the site.

Use of the Data by National, State, and Local Government Agencies

National, state and local governments use TRI data to set priorities and allocate increasingly scarce environmental protection resources to the most pressing problems.

- The U.S. Internal Revenue Service used TRI data to identify companies releasing CFCs in order to enforce a tax imposed on releases of CFCs (Smith, 1992).

- The U.S. TRI — along with similar reporting mechanisms in other countries — plays important roles in a number of international agreements (Hazen, 1997). One example includes tracking progress on the Montreal Protocol to reduce ozone-depleting substances, many of which are reported in the TRI. The Intergovernmental Forum on Chemical Safety (IFCS), which is the technical body responsible for follow up on the sound management of chemicals (Chapter 19 of Agenda 21), has formed an ad hoc group to perform assessments of 12 persistent organic pollutants, many of which appear in the U.S. TRI. The Basel Convention seeks to minimize transboundary transfers of toxic chemicals. The U.S. TRI tracks such off-site shipments.

EPA used a 1996 survey of states conducted by the National Conference of State Legislators (NCSL) to assess how states currently access and use TRI data. Table 6-5 shows how states use the data for their own purposes and for outreach efforts to their constituents. Twenty-four states produce annual TRI reports. Other state-produced documents include yearly press releases, fact sheets, computer applications with graphical displays of TRI data, chemical fact sheets, and tables of emissions quantities. The study indicated that 37 states use TRI data to identify facilities for pollution prevention activities; 22 states use the data to target facilities for inspection to ensure compliance with permits; 22 states use the data for emergency planning; 7 states develop or revise permits with the data; and 5 states use the data for facility siting and permitting decisions. Other state uses include mapping activities (including GIS), environmental equity/justice projects, and risk screening or risk analysis.

TABLE 6-5
STATE USES OF TRI DATA

St.	GIS	Enviro. Justice	Identifying Facilities for Pollution Prevention	Emergency Planning	Risk Screening	Inspection Targeting for Permitting Compliance	Developing or Revising Permit Limits	Facility Siting	Integrated TRI with Other Databases	Other
AL	n	n	y	n	n	y	n	n	n	n
AK	n	n	y	y	y	y	n	n	n	n
AZ	y	y	y	y	n	y	n	n	y	n
AR	n	n	y	n	n	y	n	n	n	n
CA	y	n	n	n	n	n	n	n	y	n
CO	y	n	y	y	n	y	n	n	y	y
CT	n	n	y	n	n	y	n	n	n	y
DC	y	y	n	y	n	n	n	n	n	n
DE	y	n	y	y	y	y	y	n	n	n
FL	y	n	n	n	n	y	y	n	y	n
GA	n	y	y	n	y	n	n	n	n	n
HI	n	n	n	n	y	n	n	n	n	n
IA	n	n	n	n	n	n	n	n	n	n
ID	n	n	n	n	n	n	n	n	n	n
IL	y	n	y	y	y	y	n	n	n	n
IN	y	n	y	y	y	n	n	n	y	y
KS	n	n	y	y	y	y	n	n	n	n
KY	n	n	y	y	y	n	n	n	n	y
LA	y	y	y	y	n	y	y	y	y	n
MA	y	y	y	n	n	y	n	n	y	n
MD	y	n	y	n	n	n	n	n	n	n
ME	n	n	n	n	n	n	n	n	n	n
MI	n	n	y	n	n	n	n	n	n	n
MN	n	n	y	n	y	n	n	y	y	y
MO	n	n	y	n	n	n	n	n	n	n
MS	n	n	y	y	y	n	n	n	y	n
MT	n	n	n	n	n	n	n	n	n	y
NC	y	n	y	n	n	n	n	n	n	y
ND	n	n	n	y	y	n	n	n	n	n
NE	n	n	y	y	y	n	n	n	y	n
NH	y	n	y	y	n	y	n	n	n	n
NJ	y	n	y	n	n	y	n	y	y	y
NM	n	n	n	y	y	n	n	n	n	n
NY	n	n	y	n	y	y	y	n	y	n

TABLE 6-5
STATE USES OF TRI DATA

St.	GIS	Enviro. Justice	Identifying Facilities for Pollution Prevention	Emergency Planning	Risk Screening	Inspection Targeting for Permitting Compliance	Developing or Revising Permit Limits	Facility Siting	Integrated TRI with Other Databases	Other
NV	n	n	n	n	n	n	n	n	n	y
OH	n	n	y	y	y	y	n	n	n	n
OK	y	y	y	n	n	y	y	n	n	y
OR	n	n	y	y	y	y	n	n	n	n
PA	n	n	y	n	n	y	n	y	n	y
RI	n	n	n	n	n	n	n	n	n	y
SC	y	y	n	n	n	n	n	n	y	n
SD	n	n	y	y	y	n	n	n	y	n
TN	n	n	n	y	n	n	n	n	n	n
TX	y	n	y	n	n	y	n	n	y	y
UT	y	n	y	y	y	n	y	n	n	n
VA	n	n	y	n	n	n	n	n	n	n
VT	n	n	y	n	y	n	n	n	n	n
WA	y	y	y	n	n	n	n	n	y	n
WI	y	y	y	n	y	n	n	n	y	n
WV	y	y	y	y	y	y	y	y	n	n
WY	n	n	n	n	n	n	n	n	n	n
PR	n	n	y	y	n	y	n	n	n	n
Total	21	10	37	22	21	22	7	5	17	12

Source: National Conference of State Legislators (1996).

To assess how TRI data use has changed in recent years, EPA compared the results of the NCSL's 1996 study with its 1994 study of TRI data use. From 1994 to 1996, state uses of TRI increased in all but three surveyed categories; state uses of TRI data remained the same in two surveyed categories and decreased in one (see Table 6-6). The greatest increase in TRI data use has been for emergency planning, data runs and analysis, integration of TRI with other databases, risk screening, and creating TRI-related Internet pages. Notably, in 1994, the use of computer technology for outreach purposes was not even included in the survey, since at the time it was not considered to be an important distribution channel. By 1996, six states had developed TRI-related web pages. The only category showing a decrease in state TRI data use is EPA TRI documents. Uses of TRI for environmental justice purposes and for facility siting remained constant, and all other 15 categories showed increasing use, as shown in Table 6-6. The increases in use averaged 4.3 states per category over this two-year period.

TABLE 6-6
CHANGE IN TRI DATA USE BY STATES

	Number of States		
State Uses of TRI Data	**1994 Total**	**1996 Total**	**Difference ('96-'94)**
GIS or other	18	21	3
Environmental justice	10	10	0
Identifying facilities for pollution prevention	34	37	3
Emergency planning	15	22	7
Risk screening	15	21	6
Inspection targeting for permitting compliance	20	22	2
Developing/revising permit limits	6	7	1
Facility siting	5	5	0
Integrated TRI with other databases	10	17	7
Other	6	12	6
State Uses of TRI Data for Outreach Purposes			
EPA TRI documents	38	37	-1
EPA diskette copies	17	22	5
TRI public reading room	13	18	3
Data runs/analysis	24	31	7
Annual state TRI report	19	24	5
TRI-related WWW pages	n/a	6	6
Other TRI documents	7	8	1
Bulletin board	n/a	2	2

Source: NCSL 1996, 1994

TRI data has provided the impetus for passage of pollution prevention laws in many states. However, states have used TRI data in many ways other than regulating industry. The following are some examples of how various states have used the TRI data:

- Louisiana's Environmental Leadership Pollution Prevention Program is a statewide emissions prevention and reduction program that seeks a 45 percent reduction in toxic chemical emissions by 1997, using 1992 data as a baseline. The program sponsors the Governor Awards for Environmental Excellence to promote public recognition of industry achievements (U.S. EPA, 1993).

- In 1993, the Minnesota legislature amended the state's EPCRA to expand TRI reporting requirements to nonmanufacturing industries. Minnesota has also used the TRI to track progress for the Minnesota-50 Project, which was a voluntary

effort by industry to reduce releases and transfers of 17 priority chemicals by 50 percent from 1988 baseline levels by 1995. Actual reductions of 52 percent were achieved by 1992 (Tomlyanovich, 1997).

- A researcher in Louisiana developed a method for normalizing the TRI data to allow comparisons among facilities, industries and states to help evaluate the comparative effectiveness of pollution control strategies, policies and programs. The method calculates an "emissions to jobs ratio", the number of pounds of emissions per job in a given industry and location. This ratio is then compared to a national or other average to determine relative performance. It also can be tracked over time to evaluate improvement. The "environment-to-jobs" ratio was included in an environmental scorecard which was developed and implemented to modify tax exemptions granted to facilities to encourage and reward job creation. If a facility's environmental score (including the "environment-to-jobs ratio") was low, the amount of the tax exemption could be decreased (Templet, 1993).

- The states of Kentucky, Ohio, and West Virginia have joined together in a "Tri-State Initiative" to identify, prevent and remediate environmental threats in an area known for its industrial base and its susceptibility to air inversions. Program coordinators are using a risk assessment process to focus on sources of greatest concern. The program will use voluntary industry commitments and cooperative efforts between industry, the public and government to achieve reductions in releases of TRI chemicals and criteria air pollutants (U.S. EPA, 1993).

- The Pollution Prevention Program of the Colorado Department of Public Health and the Environment used TRI data, in combination with other air and water emissions data and hazardous waste data, to identify 10 industry groups which are responsible for the largest quantities of hazardous waste generation or toxic emissions in the state. This study will serve as the basis for establishing priorities for pollution prevention activities and for distribution of technical assistance grants. The report also will be used to target large companies for participation in a Governor's Pollution Prevention Challenge Program to reduce toxic emissions and hazardous waste generation (Kolwey and Lynch, 1994).

- The New Jersey Department of Environmental Protection and Energy used TRI data in a computerized Geographic Information System (GIS) in order to prioritize facilities and geographic areas for implementation of pollution prevention measures. A grid system of 2 mile by 2 mile cells was used for aggregation of air releases and land releases. Minor watersheds were used to aggregate and map water releases. In order to study the cumulative impact of many releases in the area, chemicals were grouped based on health and environmental effects (Cummens, 1993).

- The Pollution Prevention Division of the state of Georgia's Department of Natural Resources used TRI data in the process of identifying the technical assistance

needs of manufacturing sectors that generate chemicals posing the greatest relative risk to public health and the environment. First, the Division prioritized chemicals based on toxicity and regulatory factors. The Division then examined manufacturing sectors releasing the highest priority chemicals and identified particular subsectors for further assessment. The program has been conducting in-depth manufacturing sector assessments, including focus groups and site visits, to determine what processes produce the wastes, what multi-media waste problems exist, what pollution prevention activities are currently being undertaken, and what additional opportunities exists (Donaghue, 1995).

- TRI data helped spur the Louisiana state legislature to require the state Department of Environmental Quality to issue regulations identifying 100 priority pollutants, setting emissions standards for those pollutants, and targeting a 50 percent emissions reduction from 1987 levels by 1994 (Tryens, *et al.*, undated).

- A public interest group report on unregulated air toxics emissions in North Carolina led the state's Environmental Management Commission to set limits for 105 air pollutants (Tryens, *et al.*, undated).

- New York State's Department of Health developed a risk screening protocol which uses TRI air release data to produce relative risk rankings for facilities and chemicals within the state. The procedure combines air emissions data and toxicity potency data to give a quantitative risk screening score for each facility. Three separate rankings were developed, based on carcinogenicity, non-cancer endpoints, and a combination of both factors. The results of these rankings suggested to the Department of Health that there is a need for more careful evaluation of potential health effects resulting from large releases of noncarcinogenic compounds such as respiratory irritants and small releases of very potent inorganic carcinogens (Recer and Johnson, 1995).

More generally, the final rule will provide social benefits through the activities of state and local agencies that are considering ways to remedy the lack of information on small releases of these toxic chemicals. By collecting this information at the federal level and making it available to the general public, limited resources at the state and local level may be used for other pollution reduction strategies.

6.4 CASE STUDY

The previous sections have introduced a theoretical framework for analyzing the social benefits of TRI information and highlighted uses of the data. Potential benefits were described from activities for broad categories of data users including consumers, industry, and government. Examples were used to characterize the specific ways that the existing TRI data has been put to use in promoting societal goals for environmental quality. However, the examples outlined thus

far do not specifically demonstrate the incremental benefits of final rule itself focusing more on the TRI as a whole.

The case study presented below is designed to stylistically illustrate the incremental benefits of the final rule. It demonstrates the incremental social benefits of the final rule through opportunities for improved decision making and policy design.

6.4.1 THE POTENTIAL BENEFITS OF MORE ACCURATE, COMPLETE, AND CONSISTENT PBT CHEMICAL REPORTING IN THE GREAT LAKES BASIN

Introduction

This case study examines the effect that the final rule could have on domestic and international research, monitoring, and policy development efforts of states in the Great Lakes Basin. The Great Lakes — Superior, Michigan, Huron, Erie, and Ontario — are an important resource. They contain roughly 18% of the global supply of fresh surface water, and the Great Lakes Basin[16] is home to more than 33 million U.S. and Canadian residents (i.e., about 10% of the U.S. population and 25% of the Canadian population), more than two-thirds of whom rely on the lakes for drinking water (U.S. EPA, 1997). The Great Lakes border six national parks and lakeshores, six national forests, at least seven national wildlife refuges, and dozens of state parks, forests, and sanctuaries, providing habitat for hundreds of species of mammals, birds, reptiles, amphibians, and fish, and thousands of species of plants. The Great Lakes system also provides recreational and economic benefits from activities such as sport fishing and boating.

However, some of the world's largest concentrations of industrial capacity are located in the Great Lakes region. Toxic releases in the basin were more than 270 million pounds in 1993 (U.S. EPA, 1996). The Great Lakes and their tributaries receive pollutant loadings generated by industry, cities, disposal sites, and agriculture. Furthermore, the large surface area of the lakes makes them vulnerable to direct atmospheric deposition of pollutants. In spite of their large volume of fresh water, the Great Lakes are extremely sensitive to pollution. Many contaminants present in the Great Lakes are PBT chemicals, and the long hydraulic retention time of the Great Lakes creates a particular susceptibility to contaminants that bioaccumulate and become concentrated in organisms at levels that greatly exceed the ambient concentrations in the open waters of the Great Lakes (40 CFR Part 132, 1993). Retention times are long — extending up to 191 years for Lake Superior — because outflows from the Great Lakes are relatively small (less than 1% per year) in comparison with the total volume of water, so pollutants that enter the lakes are not readily flushed from them (U.S. EPA, 1995; 1997). Furthermore, nutrient cycling within the system and the presence of fish and wildlife populations confined to and solely dependent on the Great Lakes Basin for food and water supplies add to the overall retention time of chemicals in the Great Lakes system (40 CFR Part 132, 1993).

[16] The U.S. portion of the basin comprises Michigan and parts of Minnesota, Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, and New York.

Consequently, concentrations of PBT chemicals in the ecosystem have reached levels that have the potential to increase the risk of cancer, birth defects, genetic mutations, and reproductive impacts in fish, bird, and mammal populations, even though the concentrations in water may be so low as to be undetectable by available analytical techniques. For example, as a result of contamination from historical loadings of bioaccumulative chemicals, the Great Lakes states have issued 164 fish consumption advisories recommending reduced or no consumption of specific fish species in the Great Lakes system. Currently, all of the Great Lakes and their connecting waters are under fish consumption advisories, which are summarized in Table 6-7 (U.S. EPA, 1997). The most common advisories are for PCBs, and Lake Superior has advisories for five separate types of PBT chemicals.

TABLE 6-7
SUMMARY OF FISH CONSUMPTION ADVISORIES
FOR THE GREAT LAKES

Chemical	Lake Superior	Lake Huron	Lake Michigan	Lake Erie	Lake Ontario
PCB	" !	" !	" !	" !	" !
Chlordane	" !	" !	" !	!	" !
Dioxins	" !	" !			
Mercury	" !		"		
Toxaphene	" !				

Key:
" Denotes the presence of partially restricted consumption advisories for the general population.
! Denotes the presence of fully restricted consumption advisories for the general population.
Note: Each lake has multiple advisories. They differ across locations, fish species, and within species (e.g., by size of fish). Some lakes also have advisories that pertain to specially sensitive populations such as pregnant and nursing women.

Source: U.S. EPA, 1997

According to the National Water Quality Inventory 1996 Report to Congress (U.S. EPA, 1998), the Great Lakes states assessed water quality for approximately 94% of the total U.S. Great Lakes shoreline (about 5,185 miles) in 1996. The assessment found that although 89% or more of the surveyed shoreline area supported agricultural, drinking water, or primary or secondary contact uses, only 2% fully supported all uses, including fish consumption; 34% of the shoreline miles surveyed were classified as partially supporting fish consumption use, and 64%

were classified as not supporting fish consumption. (U.S. EPA, 1998). This combination of low water quality impairment for contact and drinking water uses and high level of water quality impairment for fish consumption is indicative of the presence of toxic chemicals that persist and bioaccumulate in the system.

The presence of PBT chemicals such as those in the final rule and their associated human health and ecosystem risks have been the focus of national and international research and regulatory efforts in the Great Lakes Basin for many years. However, a lack of information about the sources of these contaminants has limited efforts to characterize existing health and ecosystem risks, to assess potential benefits of efforts to improve water quality, and to monitor progress. This case study discusses three types of social benefits of the final rule in the context of efforts to improve water quality in the Great Lakes Basin.

The first type of social benefit concerns filling in data gaps that have historically hampered research efforts in the region. This section illustrates the past effect of data gaps by describing how missing information on sources of PBT chemicals in the basin affected the effort to establish water quality standards under the Great Lakes Water Quality Initiative. By providing more detail on sources of PBT chemicals, the final rule will benefit ongoing efforts to understand the risks posed by contaminants in the basin and to evaluate policy strategies that address the risks.

The second type of social benefit is the provision of additional data to monitor progress toward achieving the toxic chemical reduction goals of various international agreements. For example, the United States and Canada adopted the Binational Great Lakes Toxics Strategy (Binational Strategy) in 1997, which seeks to implement the Great Lakes Water Quality Agreement's (GLWQA) goal to virtually eliminate the release of certain PBTs such as mercury, PCBs, and dioxin-like compounds. The final rule would provide a means for tracking and reporting annual progress toward achieving this goal.

The third type of social benefit pertains to a consistent reporting framework at the national level. The Great Lake states are responding to the lack of PBT chemical release information by adopting their own reporting rules, which differ across states. The final rule will create uniformity in reporting requirements, which will be less costly and so directly benefit reporting industries. Furthermore, a nationwide data set based on uniform reporting rules will be more valuable to researchers and policy makers than a patchwork data set.

Potential Social Benefits of Filling in Data Gaps

Water quality problems associated with PBT chemicals in the Great Lakes became apparent in the 1960s and 1970s with the detection of high contamination levels in fish. These problems were investigated through a joint endeavor of the Great Lakes states and EPA called the Great Lakes Water Quality Initiative (GLWQI). The joint effort evaluated health and ecosystem risks in the basin and evaluated policy options that resulted in the 1995 Great Lakes Water Quality Guidance (the Guidance; 40 CFR Part 132, 1995). The Guidance provides direction on minimum water quality standards that specifically take the ability of persistent chemicals to bioaccumulate into consideration. Several of the PBT chemicals in the final rule were also

addressed in the Guidance. Table 6-8 lists these chemicals. It also shows which of the PBT chemicals in the final rule are addressed in other research or policy development efforts, which are discussed in this case study.

TABLE 6-8
PBT CHEMICALS REGULATED UNDER FINAL RULE THAT WERE ADDRESSED IN GREAT LAKES WATER QUALITY GUIDANCE AND OTHER RESEARCH AND REGULATORY EFFORTS DISCUSSED IN THIS CASE STUDY

Chemical/Chemical Group	Great Lakes Water Quality Guidance	Great Lakes Air Toxics Emissions Inventory	Great Waters	UNEP Persistent Organic Pollutants	Binational Strategy
Pesticides					
Aldrin	✓			✓	✓
Methoxychlor		✓			
Trifluralin		✓			
Chlordane	✓	✓	✓	✓	✓
Heptachlor	✓	✓		✓	
Toxaphene	✓		✓	✓	✓
Polycyclic Aromatic Compounds		✓ [a]	✓ [b]		
Benzo(a)pyrene	✓	✓			✓
Benzo(a)anthracene		✓			
Benzo(j,k)fluorene		✓			
Metals/Metal Compounds					
Mercury/mercury compounds	✓	✓	✓		✓
Total Polychlorinated Dibenzo-p-dioxins		✓	✓	✓	✓
2,3,7,8-TCDD only	✓				
Polychlorinated Dibenzofurans		✓	✓	✓	✓
Other Chemicals					
Hexachlorobenzene	✓	✓	✓	✓	✓
Pentachlorobenzene	✓				
PCBs	✓	✓	✓	✓	✓

Sources: U.S. EPA (1995), Great Lakes Commission (1998), U.S. EPA (1997), U.S. EPA and Environment Canada (1997), and United Nations Environment Programme (1997)
Notes:
a. The Great Lakes Air Toxics Inventory includes total polycyclic aromatic compounds.
b. The Great Waters pollutants of concern include total polycyclic organic matter, including PACs from combustion.

Throughout the GLWQI development process, insufficient information about PBT chemical sources and emissions levels affected researchers' ability to accurately assess relative contributions of point source PBT chemical loadings to the Great Lakes. The regulatory impact analysis (RIA; U.S. EPA, 1995) for the Guidance demonstrates the effects of data gaps in the consideration of potential water quality improvement benefits of the Guidance. The RIA attempted to estimate potential benefits of reduced concentrations of PBT chemicals such as mercury, PCBs, and dioxin in fish tissue. The concentration reductions were based on expected loadings reductions as a result of the Guidance from point sources that discharge PBT chemicals to water. However, because point source loadings are not the only source of PBT chemicals in the basin (i.e., nonpoint sources and atmospheric deposition are other sources), the study needed to estimate the percentage of total loadings to the lakes that could be attributed to point sources.

This attribution process relied on limited available information about relative point source contributions and total loadings. The RIA acknowledged this insufficiency: "In general, there is insufficient data available to estimate total basin wide loadings (and thus calculate the relative point source contribution) for almost all of the contaminants addressed by the Guidance, and results are likely to be highly site- and contaminant-specific" (U.S. EPA, 1995, p. S-4). The TRI will capture multi-media emissions to air, water and land. The research used to support the attribution assumptions used in the RIA to estimate potential benefits of reducing loadings from effluent point sources (Table 6-9) was limited to direct water discharges and included the following:

TABLE 6-9
ESTIMATED SHARE OF TOTAL LOADINGS ATTRIBUTABLE TO EFFLUENT POINT SOURCES USED IN THE GREAT LAKES WATER QUALITY GUIDANCE REGULATORY IMPACT ANALYSIS[a]

Great Lake	Percentage[b]
Superior	1-2%
Michigan	5-10%
Huron	5-10%
Erie	10-15%
Ontario	10-15%

Source: U.S. EPA (1995)
a. These shares were based on the limited number of available research on relative point source contributions and total loadings: Strachan and Eisenreich (1988), Warren (1993), and Bierman et al. (1992).
b. Percentage of total loadings attributable to effluent point sources only.

- Strachan and Eisenreich (1988) estimated that the contribution of industrial and wastewater point sources to total loadings of lead and PCBs in Lake Superior ranged from 0.7% to 1.5%, and the contribution for Lake Huron ranged from 2.0% to 7.0%. They also estimated that atmospheric contributions of PCBs to the lakes ranged from 90% for Lake Superior to 7% for Lake Ontario. They concluded that high pollutant loadings from sources along the Detroit-St. Clair and Niagara river systems implied higher contribution levels to the lower lakes (i.e., Lake Erie and Lake Ontario) than the upper lakes.

- Bierman et al. (1992) estimated that point sources contributed 9.4% of PCB loadings to Lake Michigan's Green Bay.

- Warren (1993) estimated total loadings to the lakes that implied point source contributions of 2% to 40% of basin wide loadings of mercury, lead, cadmium, and PCBs.

For lack of better information, these estimates of point source contributions for a few contaminants in four water bodies were assumed to represent all contaminants in all of the Great Lakes. The implication for the Guidance benefits analysis is that the RIA underestimated social benefits if point sources contribute a greater share of total loadings for a particular contaminant, and it overestimated benefits if point sources contribute a smaller share than projected.

The final rule would provide detailed information on the locations and amounts of PBT chemical releases to all environmental media. This type of information could be used to fill data gaps such as the one encountered by the Guidance.[17] Table 6-10 lists some of the ongoing research and toxic pollution control efforts in the basin that could benefit from the data provided by the final rule. The inventory and modeling efforts would benefit from more complete data on sources of PBT chemicals. For example, the eight Great Lakes states are developing annual inventories of air emissions of 49 chemicals, including several in the final rule (see Table 6-8). Only Wisconsin has a state inventory publicly available at this time. The other states are either reporting incomplete data from the existing TRI or they are estimating emissions by combining production activity levels with applicable emissions factors and speciation factors in a model called the Regional Air Pollutant Inventory Development System (RAPIDS). The final rule would provide additional information for the states to use in their inventories or to validate inventory data developed using RAPIDS.

[17] A similar attribution approach based on limited information was used in the Great Lakes Basin Risk Characterization Study (U.S. EPA, 1991). The study used the source load proportions for only two rivers (St. Clair and St. Marys) as the basis for a preliminary allocation of the non-atmospheric human health risk estimates to point and nonpoint sources.

TABLE 6-10
SUMMARY OF THE TYPES OF RESEARCH AND TOXIC POLLUTION CONTROL EFFORTS IN THE GREAT LAKES BASIN THAT COULD BENEFIT FROM THE FINAL RULE

Effort	Description
Great Lakes Air Toxics Emissions Inventory	This will be an annual inventory of sources and source category emissions for 49 toxic chemicals in the Great Lakes region.
Lake Michigan Monitoring Program/Lake Michigan Mass Balance Study	This research program is developing the scientific baseline for future toxic chemical load reduction efforts at all government levels. The mass balance study is a coordinated effort to quantify and understand loadings, transport, and fate of selected toxic chemicals (PCBs, mercury, and trans-nonachlor — a bioaccumulative component of chlordane) for Lake Michigan. The study will also provide a validated method to estimate loadings for other water bodies.
Great Lakes Water Quality Guidance	The Guidance promulgates standardized water quality criteria to protect human health, wildlife, and aquatic life in the basin, and contains implementation guidelines for industrial and municipal water discharge point sources.
Lakewide Management Plan (LaMP)	Under the GLWQA, U.S. and Canadian governments are developing LaMPs, which are coordinating mechanisms for reducing loadings of critical pollutants to each lake. The components of a LaMP include developing a summary of contaminant sources and loads, identifying measures to prevent or control loadings, and monitoring progress to restoring beneficial uses.

Source: U.S. EPA (1997)

The data would also provide social benefits by helping improve the characterization of sources of PBT chemicals to the Great Lakes and monitoring progress toward loadings reduction goals. For example, under the Guidance, states may propose alternatives to implementation guidelines regarding industrial and municipal water discharge sources if the PBT chemical release

data suggest that other strategies such as air emissions controls are more cost-effective. Furthermore, facility-level information on PBT chemical releases might also reveal that certain facilities or industries account for large release percentages. This can help agencies set priorities in achieving water quality improvement goals in the basin.

Similar social benefits may occur throughout the country, particularly in regions that have similar water quality problems caused by air emissions. Section 112(m) of the Clean Air Act requires EPA to report to Congress periodically on the effects of air pollution on water pollution problems for the Great Waters, which include large lakes such as the Great Lakes and coastal waters such as Chesapeake Bay. There are 15 pollutants of concern for Great Waters, many of which are PBT chemicals in the final rule (see Table 6-8). Consequently, the final rule will provide valuable emissions data for ongoing efforts to study the effects of air emissions on the Great Waters.

Potential Social Benefits for International Efforts Regarding PBT Chemicals

The U.S. TRI — along with similar reporting mechanisms in other countries — plays important roles in a number of international agreements (Hazen, 1997). One example is tracking progress on the Montreal Protocol to reduce ozone-depleting substances, many of which are reported in the TRI. More complete data on PBT chemicals will similarly provide social benefits in terms of tracking the United States' progress in meeting the goals of international agreements that target reductions in toxic chemical releases. For example, the United Nations Environment Programme (UNEP) decided to begin negotiations on a treaty to reduce global releases of persistent organic pollutants (United Nations Environment Programme, 1997). Many of the 12 pollutants targeted for reductions are PBT chemicals in the final rule (see Table 6-8). Furthermore, through the Commission for Environmental Cooperation (CEC), which addresses transboundary and regional environmental problems in North America, Canada, Mexico, and the United States are developing regional action plans to phase-out or manage four persistent chemicals including chlordane, PCBs, and mercury. Consequently, the final rule would assist the United States monitor its progress toward the goals adopted by the CEC and the UNEP. Furthermore, U.S. action in developing a more comprehensive inventory of PBT chemical releases will also provide social benefits associated with improved information for the international community because these chemicals are transported throughout the world. Finally, if the international community is encouraged to reciprocate, and compile and publish their PBT chemical release inventories, then the United States will benefit from a more comprehensive global inventory of these chemicals.

In the Great Lakes Basin, more complete data on PBT chemicals will also provide benefits in terms of tracking progress toward the Great Lakes Binational Strategy. In August 1993, a task force of the International Joint Commission (IJC) recommended a strategy for virtually eliminating the input of persistent toxic substances into the Great Lakes Basin (IJC, 1993). This strategy was developed to support the virtual elimination goal of the Great Lakes Water Quality Agreement, under which the United States and Canadian governments established common water quality objectives for the Great Lakes system. To protect human health and the ecosystem, the IJC believes that it is necessary to virtually eliminate present inputs of persistent toxic substances

and to prevent future inputs (IJC, 1993). According to the IJC statement, it is the persistence of these toxic substances in the environment, rather than simply their toxicity, that provides a compelling case for their elimination.

The IJC study encountered the same data gaps as the GLWQI. The 1993 report found that limited, if any, data existed on sources, uses, and releases for a wide range of chemicals. Because the IJC study considered U.S. and Canadian releases to the Great Lakes, its data difficulties were further exacerbated by inconsistencies in the collection and reporting of data in the Great Lakes system. The study concluded that it is imperative that a better characterization of what is being input be established. The findings of the IJC (1993) regarding data needs are as follows:

- A major problem with current mass balance modeling efforts is lack of baseline information. Accurate and consistent information about sources and pathways, as well as relative contributions, must be available for the United States, Canada, and internationally.

- Thus, the parties should enhance programs to identify sources and pathways and to quantify loadings to the Great Lakes Basin. The United States' TRI and Canada's National Pollutant Release Inventory (NPRI) should be consistent and compatible and both should apply to all sectors.

- Further, reporting thresholds should be lowered.

- Finally, the IJC recommends that both countries' programs must broaden the list of reportable chemicals to include all persistent, bioaccumulative chemicals.

The final rule adds several PBT chemicals to the list of chemicals that require TRI reporting including dioxin-like substances, and lowers thresholds for PBT chemicals, including 7 of the 11 critical pollutants that the IJC focused on: PCBs, toxaphene, dioxins, furans, mercury, benzo(a)pyrene, and hexachlorobenzene. Consequently, the final rule directly addresses the IJC's recommendations and, thereby, demonstrates the United States' commitment to the binational effort to improve Great Lakes water quality.

The subsequent Binational Great Lakes Toxics Strategy specified reduction targets for several chemicals, many of which are included in the final rule (see Table 6-8) (U.S. EPA and Environment Canada, 1997). It also encourages pollution prevention activities for other chemicals, some of which are included in the final rule (e.g. heptachlor and polycyclic aromatic compounds). Consequently, the final rule will enable the United States to monitor its progress toward meeting the reduction and pollution prevention goals of the Great Lakes Water Quality Agreement as specified in the Binational Strategy. For example, the United States seeks a 50% reduction in anthropogenic releases of mercury and a 75% reduction in releases of dioxin-like compounds by 2006. These reductions apply to all national air emissions and to releases to water in the Great Lake Basin. The Great Lakes Emissions Inventory described above will be

insufficient to track the United States' progress because it is a regional inventory of toxic air emissions. Under the final rule, the TRI will contain mercury and dioxin release data at the national level, and it would contain releases to water as well, all of which could be used to track progress.

Social Benefits of Uniform Reporting Requirements

The absence of federal reporting requirements for PBT chemicals that are released below the current TRI thresholds has created a situation wherein states are adopting their own reporting requirements.[18] For example, since 1987, Minnesota has tried to conduct hazard assessments and implement policies that address mercury contamination problems in the state; e.g., nearly 700 lakes have fish consumption advisories (Minnesota Department of Health, 1997; Andrews, 1998). As with the Guidance, research efforts in Minnesota were hampered by a lack of data on releases of mercury. In particular, researchers have wondered, "Where is the mercury in the TRI?" (S. Tomlyanovich, Minnesota Emergency Response Commission, personal communication, 1998). To alleviate the data gaps, Minnesota added electric utilities to the list of industries required to report TRI data in 1993. However, electric utilities applied for a fossil fuel exemption that the state act allowed, and thereby avoided reporting mercury emissions (Tomlyanovich, 1997). Last year, the state passed a law requiring utilities to report mercury emissions if (1) emissions exceed 3 pounds per year, (2) a generation unit's capacity exceeds 15 MW, (3) production exceeds 150 million Btu per hour, and (4) a generation unit operates for more than 240 hours per year (Minnesota Code, Ch. 191, Art. 2, Sec. 2, 1997). This will help the state develop its own mercury emissions inventory and develop strategies to reduce emissions.

In contrast to the Minnesota rule, the reporting threshold for mercury in Wisconsin ranges from 3.7 to 37 pounds per year, depending on the speciation of mercury release. Other states in the Great Lakes Basin have yet to adopt reporting requirements of toxic releases beyond the TRI. The resulting patchwork of differing state laws concerning important environmental data collection is undesirable and inefficient for at least three reasons:

- U.S. residents' right to know about releases of PBT chemicals that affect their communities should not depend on where they live.

- Lack of uniformity in requirements will make reporting difficult for businesses that operate in multiple states. For example, utilities with generation units in Minnesota and Wisconsin will need to comply with different reporting standards. Furthermore, Minnesota requires reporting on releases from out-of-state units owned by in-state facilities. This means that companies such as Northern States Power with units in Wisconsin that export power to Minnesota will have to report

[18] At least one local community has also adopted requirements for reporting of chemical releases, including PBT chemicals, at low thresholds. The residents of Eugene, Oregon, passed Amendment IV to the City Charter in 1996, which requires facilities in selected industries (SIC categories 20-39) to file an annual, public, materials balance report that lists inputs and outputs of all hazardous substances obtained, used, or generated. The reporting threshold is 2,640 pounds of hazardous inputs per year.

releases from their Wisconsin units to both states under different requirements. This raises concerns about data set compatibility and potential double-counting (E. Swain, Minnesota Pollution Control Agency, personal communication, 1998).

- PBT chemicals can be transported great distances via air or water, which means that states are affected by releases in other states. For example, Engstrom and Swain (1997) characterized potential emissions sources of mercury deposition for Minnesota based on analyses of core sediments from lakes in Minnesota and Alaska. They concluded that about 40% of the mercury contamination in Minnesota comes from anthropogenic sources in the state; the remainder comes from regional and global sources. This means that Minnesota's mercury reporting requirement will capture less than one-half of the releases that affect its environment and, thus, used alone may be misleading regarding source and magnitudes of emissions that affect the state. In general, missing emissions data or different data across states pose difficulties for research efforts that require interstate data comparisons or analysis.

The final rule will establish uniform reporting requirements at the national level, which may provide social benefits through the use of the TRI data by consumers, and government, and may simplify industry reporting efforts. All U.S. residents will benefit from improved access to information about PBT chemical releases that affect their communities, particularly those who are not aware that such releases are occurring in their communities. A uniform national rule will benefit businesses who would otherwise have to comply with reporting requirements that differ across states.[19] A uniform reporting requirement would benefit federal, state, and local agencies by providing PBT chemical release information nationwide, which could improve risk assessment and regulatory analysis. Furthermore, a national reporting rule that provides states with information that they need will free state and local governments from the burden of allocating scarce resources toward legislating their own reporting requirements.

Summary

The final rule will generate valuable information on emissions of PBT chemicals that are causing water quality problems in the Great Lakes Basin and elsewhere. This information will provide social benefits in a variety of ways. First, it will improve efforts to understand the transport of PBT chemicals by providing detailed information on release sources, in particular air emissions, which affect water quality. PBT chemical release information will also help public agencies develop more effective strategies for addressing environmental problems, and provide a

[19] States may continue to establish reporting thresholds that are lower than those prescribed in the final rule. For example, depending on which option for the final rule is selected, the states of Minnesota and Wisconsin may continue to have lower thresholds for some of the chemicals. Wisconsin's emissions reporting thresholds in pounds per year for other PBT chemicals in the final rule are: aldrin (91), selected PACs (12 pounds each including benzo(a)pyrene, benzo(b)fluoranthene, benzo(a)anthracene, dibenzo(a,h)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)acridine, dibenz(a,j)acridine, benzo(a)phenanthrene, benzo(j,k)fluorene), cobalt (18), hexachlorobenzene (12), PCBs (0.050), and 2,3,7,8-TCDD (0.00005) (State of Wisconsin, Administrative Code, NR 438).

means of monitoring and tracking progress toward goals. Because the United States is also a participant in various international efforts to reduce or manage PBT chemicals, the final rule will also assist in monitoring its progress in these arenas. Finally, uniform national reporting provides social benefits to consumers nationwide who use the information to learn more about their potential exposure to PBT chemicals, and it provides benefits to the reporting facilities that would otherwise face a variety of different reporting requirements established at the state and local level.

6.5 SUMMARY

In enacting EPCRA and PPA, Congress recognized the significant benefits of providing information on toxic chemical releases and other waste management activities. TRI has proven to be one of the most powerful forces in empowering the federal government, state and local governments, industry, environmental groups and the general public to fully participate in an informed dialogue about the environmental impacts of toxic chemicals in the United States. TRI's publicly available data base provides quantitative information on toxic chemical releases and other waste management activities. With the collection of this information starting in 1987 came the ability for the public, government, and the regulated community to understand the magnitude of chemical releases in the United States, and to assess the need to reduce the uses and releases of toxic chemicals. TRI enables all interested parties to establish credible baselines, to set realistic goals for environmental progress, and to measure progress in meeting these goals over time.

The TRI system has become a neutral yardstick by which progress can be measured by all stakeholders. The information reported to TRI increases knowledge of the levels of toxic chemicals released to the environment and the potential pathways of exposure, improving scientific understanding of the health and environmental risks of toxic chemicals; allows the public to make informed decisions on where to work and live; enhances the ability of corporate leaders and purchasers to more accurately gauge a facility's potential environmental liabilities; provides reporting facilities with information that can be used to save money as well as reduce emissions; and assists federal, state, and local authorities in making better decisions on acceptable levels of toxics in the environment.

PBT pollution suggests two distinct types of market failure: negative externalities, and asymmetric information. As a consequence, economic theory suggests that the social benefits of having access to information on PBT chemicals in order to address these market failures may be large. These benefits can be identified through a detailed analysis of the ways in which different groups of economic actors -- consumers, industry, non-federal governments and the general public -- utilize the TRI data. Consumers may use the data to make more informed decisions about the products they buy and to enter into constructive dialogue with the PBT-emitting firms in their communities. Industry may find opportunities for waste reduction and cost savings through developing data to be used in the final rule. Non-federal governments may use the data in lieu of or in support of their own environmental protection activities. In addition, non-users of the TRI data benefit from its public provision whenever others use of the data results in improvements in environmental quality.

Moreover, economic theory suggests an important role for government action embodied in the form of the final rule because of the persistent and bioaccumulative characteristics of these chemicals. Pollutants must either be physically altered and/or diluted in the environment so as not to cause health or environmental damages. The characteristics of PBT chemicals are counter to both of these conditions. Persistence and bioaccumulation in the environment requires that the social benefits analysis appropriately address time and the diverse group of resource users and uses that are affected. Because of these and other characteristics, PBT chemicals fit the definition of "post experience goods," goods whose attributes remain unknown for an indefinite period of time. EPA's analysis draws on the literature concerning the economics of information to conclude that in the case of post experience goods, a significant asymmetric information problem exists and in absence of government intervention, private market forces are unlikely to address consumers needs for this type of information.

EPA has not attempted to monetize the benefits [Willingness to Pay] of the final rule for several reasons related to the paucity of data on users and non-users of the TRI. The analysis was not able to consider variations in quality or other attributes of different methods of TRI data access. Finally, the potentially large numbers of beneficiaries who are not users of the data further limits EPA's ability to quantify potential benefits. EPA finds that electronic access to TRI data is common by consumers and industry. Ready access to TRI data has spawned a literature of reports and analyses using TRI data to investigate all types of issues, ranging from fate and transport of heavy metals to issues of environmental justice. EPA has identified about 500 articles, reports and other products that use TRI data.

Finally, EPA has developed a case study to illustrate potential social benefits of the final rule. The case study examines the Great Lakes where past efforts to characterize risks posed by PBT chemicals and estimate the benefits of loadings reductions were hampered by a lack of information on sources and quantities of chemical releases. By filling in such data gaps, the final rule will benefit ongoing research efforts to understand the risks posed by contaminants in the basin and to evaluate policy strategies that address the risks. Furthermore, a comprehensive and detailed data set on PBT chemical releases will assist in policy development at the international, national and regional level.

LITERATURE CITED

1. Andrews, C. 1998. "Minnesota's Mercury Contamination Reduction Program: Working Together for a Safer Environment." *Health and Environment Digest* 12: 17-21.

2. Arora,, Seema and Timothy N. Cason, Why Do Firms Volunteer to Exceed Environmental Regulations? Understanding Participation in EPA's 33/50 Program, *Land Economics* 72(4), 413-432 (1996).

3. Arora,, Seema and Timothy N. Cason, An Experiment in Voluntary Environmental Regulation: Participation in EPA's 33/50 Program, *Journal of Environmental Economics and Management* 28, 271-286 (1995).

4. Atlas, Mark, TRI, TRI Again: Correctly Interpreting Toxics Release Inventory Data, presented at the National Conference on Environmental Decision Making, Knoxville, TN, (May 1998).

5. Bierman, V.J., J.V. DePinto, T.C. Young, P.W. Rodgers, S.C. Martin, and R. Raghunathan. 1992. Development and Validation of an Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan. Gross Isle, MI: U.S. Environmental Protection Agency.

6. Blacconiere, Walter G. and Dennis M. Patten, Environmental Disclosures, Regulatory Costs, and changes in Firm Value, *Journal of Accounting and Economics* 18, 357-377 (1994).

7. Boardman, Anthony E., David H. Greenberg, Aidan R. Vining and David L. Weimer, *Cost-Benefit Analysis: Concepts and Practice*, Upper Saddle River, NJ: Prentice-Hall Inc., 1996.

8. Brooks, Nancy and Rajiv Sethi, The Distribution of Pollution: Community Characteristics and Exposure to Air Toxics, *Journal of Environmental Economics and Management* 32, 233-250 (1997).

9. Burke, Lauretta M., 1993. Environmental Equity in Los Angeles (Santa Barbara: University of California Center for Geographic Information and Analysis, July).

10. Citizens Fund, 1993. Poisons in Our Neighborhoods: Toxic Pollution in the United States (Washington, DC: Citizens Fund, November).

11. Citizens Fund, 1992. Manufacturing Pollution (Washington, DC: Citizens Fund, August).

12. Coase, R. H., "The Problem of Social Cost," *Journal of Law and Economics* 1 (October 1960): 1-44.

13. Cummens, Pat, 1993. Untitled presentation, in Proceedings: Toxics Release Inventory (TRI) Data Use Conference (Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, July).

14. Davis, J. Ronnie and Joe R. Hulett, *An Analysis of Market Failure: Externalities, Public Goods, and Mixed Goods*, Gainesville: University Press of Florida, 1977.

15. Doer, Lisa, 1995. "How TRI Can Drive Pollution Prevention," in Proceedings: Toxics Release Inventory (TRI) Data Use Conference: Building TRI and Pollution Prevention Partnerships (Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, March).

16. Donaghue, Bob, 1995. "Prioritizing Pollution Prevention Assistance Needs Using the 1992 Toxic Release Inventory," in Proceedings: Toxics Release Inventory (TRI) Data Use Conference: Building TRI and TRI and Pollution Prevention Partnerships (Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, March).

17. Environmental Defense Fund. 1998a. "Giant Step for Public's Right-to-Know About Chemical Hazards." (http://www.edf.org/pubs/NewsReleases/1988/Apr/c_scorecard.html) Accessed on June 9, 1998.

18. Environmental Defense Fund. 1998b. "The Chemical Scorecard." (http://www.scorecard.org/about-technology.tcl) Accessed on May 28, 1998.

19. Engstrom, D.R. and E.B. Swain. 1997. "Recent Declines in Atmospheric Mercury Deposition in the Upper Midwest," *Environmental Science and Technology*, Vol. 31, No. 4, pp. 960-967.

20. Field, Barry, *Environmental Economics: An Introduction*, McGraw-Hill, Inc., 1994.

21. Fiorino, Daniel J., Technical and Democratic Values in Risk Analysis, *Risk Analysis* 9(3), 293-299, (1989).

22. Great Lakes Commission. 1998. Great Lakes Regional Air Toxics Emissions Inventory Targeted Toxic Compounds. http://www.glc.org/projects/air/49tox.html. Accessed 7/01/98.

23. Great Lakes Information Network, 1996. "Regional Air Pollutant Inventory Development System," Information from Great Lakes Information Network World Wide Web site: (http://www.glc.org/projects/air/rapids/rapids.html)

24. Greene, Terry, 1995. "JSI Community Outreach Project," in Proceedings: Toxics Release Inventory (TRI) Data Use Conference: Building TRI and Pollution Prevention Partnerships (Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, March).

25. Gregory, M. 1997. "A List of Lists for the US-Mexico Border Region." 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, p. 8-10. EPA/749-R-98-001. Washington, D.C.: U.S. EPA.

26. Haldeman, K. 1997. "What Information Do Our Communities Need: Investor Research Organizations?" 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, p. 112-114. EPA/749-R-98-001. Washington, D.C.: U.S. EPA.

27. Hamilton, James T., Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data, *Journal of Environmental Economics and Management* 28, 98-113 (1995).

28. Hartmann, Carolyn, 1993. Troubled Waters: Major Sources of Toxic Water Pollution (Washington, DC: U.S. Public Interest Research Group, June).

29. Hausman, Rick, 1993. "Environmental Investing: Dollars and Change," Online: The RTK NET Newsletter, Vol. 3, No. 2 (Fall).

30. Hazen, S. 1997. "International TRI and Their International Uses." 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, p. 155-158. EPA/749-R-98-001. Washington, D.C.: U.S. EPA.

31. International Joint Commission. 1993. A Strategy for Virtual Elimination of Persistent Toxic Substances: Seven Reports to the Virtual Elimination Task Force. Windsor, Ontario: International Joint Commission.

32. Konar, Shameek and Mark A. Cohen, Information As Regulation: The Effects of Community Right to Know Laws on Toxic Emissions, *Journal of Environmental Economics and Management* 32, 109-124 (1997).

33. Kolwey, Neil and Margery Lynch, 1994. Pollution Prevention Priorities: A Study of Priorities for Pollution Prevention Activities in Colorado (Colorado Pollution Prevention Advisory Board, May).

34. Lattimer, R.E. 1997. "Data Quality — Plant Site Perspective." 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, p. 13-17. EPA/749-R-98-001. Washington, D.C.: U.S. EPA.

35. Lynn, Frances M. and Jack D. Kartez, Environmental Democracy in Action: The Toxics Release Inventory, *Environmental Management* 18(4), 511-521, (July/August 1994).

36. MacLean, Alair and Paul Orum, 1992. Progress Report: Community Right-to-Know (Washington, DC: OMB Watch and Working Group on Community Right-to-Know, July).

37. MacLean, Alair and Rich Puchalsky, 1994. Where the Wastes Are: Highlights from the Records of the More Than 5,000 Facilities that Receive Transfers of TRI Chemicals (Washington, DC: OMB Watch and Unison Institute, April).

38. McLure, Pam, 1994. "Georgia on My Mind", Online: The RTK NET Newsletter, Vol. 4, No. 1 (Summer).

39. Mills, Edwin S. and Philip E. Graves, *The Economics of Environmental Quality*, New York: W.W. Norton, 1986.

40. Minnesota Department of Health. 1997. Minnesota Fish Consumption Advisory. St. Paul: Minnesota Department of Health.

41. National Conference of State Legislatures (NCSL), 1996. "1996 State TRI Program Assessment."

42. National Conference of State Legislatures (NCSL), 1994. "1994 State TRI Program Assessment."

43. Nelson, Phillip, Information and Consumer Behavior, *Journal of Political Economy* 78(2), 311-329, (1970).

44. "Notes from the Field: Students Use SARA Title III Data to Conduct Local Toxic Waste Audits," Hazardous Materials Dialogue, Vol. 4, No. 1, 1992.

45. Orum, Paul and Beth Wohlberg, 1994. "Reports Using Toxics Release Inventory (TRI) Data," Working Notes on Community Right to Know, July-August.

46. Pine, J. 1997. "Louisiana Environmental Leadership Pollution Prevention Program." 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, pp. 61-63. EPA/749-R-98-001. Washington, D.C.: U.S. EPA.

47. Recer, Gregg, and Thomas Johnson, 1995. "Risk Screening in New York State Using Toxic Release Inventory Data," in Proceedings: Toxics Release Inventory (TRI) Data Use Conference: Building TRI and Pollution Prevention Partnerships (Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, March).

48. Rice, Faye, 1993. "Who Scores Best on the Environment," Fortune, Vol. 128, No. 2 (July 26, 1993).

49. Reilly, W. 1997. “Analytical Review of Source Reduction Activities by SIC as Reported in Section 8.10 of the Form R for EPA Region III for 1993-1995.” 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, p. 40. EPA/749-R-98-001. Washington, D.C.: U.S. EPA.

50. Riley, Gwen J., John L. Warren and Eun-Sook Goidel, Assessment of Changes in Reported TRI Releases and Transfers Between 1989 and 1990, *Air and Waste* 44, 769-772, (June 1994).

51. Saukaitis, I. 1997. “Session B: How Can TRI be Used to Provide Environmental Impact and Health Assessment.” 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, p. 65. EPA/749-R-98-001. Washington, D.C.: U.S. EPA.

52. Schubert, S. 1997. “CHEC Speaks Out on the Toxic Release Inventory.” 1997 Toxics Release Inventory and Right-to-Know Conference Proceedings, p. 28-32. EPA/749-R-98-001. Washington, D.C.: U.S. EPA

53. Settina, Nita and Paul Orum, 1991. Making the Difference, Part II: More Uses of Right-to-Know in the Fight Against Toxics (Washington, DC: Center for Policy Alternatives and Working Group on Community Right-to-Know, October).

54. Smith, Ted, 1992. Untitled presentation, in Proceedings: Toxic Release Inventory (TRI) Data Use and Pollution Prevention Conference (Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, June).

55. Stockwell, John R., Jerome W. Sorenson, James W. Eckert, Jr., and Edward M. Carreras, The U.S. EPA Geographic Information System for Mapping Environmental Releases of Toxic Chemical Release Inventory (TRI) Chemicals, Risk Analysis 13(2), 155-164, (1993).

56. Strachan, W.M.J. and S.J. Eisenreich. 1988. Mass Balancing of Toxic Chemicals in the Great Lakes: The Role of Atmospheric Deposition. Prepared for the International Joint Commission. May. 113 pp.

57. State of Wisconsin Administrative Code, 1993 (Revised 1996). Air Contaminant Emission Inventory Reporting Requirements, Chapter NR 438.

58. Templet, Paul H., 1993. “The Emissions to Jobs Ratio,” Environmental Science and Technology, Vol. 27, No. 5 (May).

59. Texas Network for Environmental and Economic Justice, 1993. Toxics in Texas and their Impact on Communities of Color (Austin, TX: Texas Network for Environmental and Economic Justice, March).

60. Tietenberg, Thomas H., *Environmental and Natural Resource Economics*, New York, NY: HarperCollins Publishers Inc., 1992.

61. Tomlyanovich, S. 1997. "Minnesota State Agency's Use of the Toxic Release Inventory 1997." Toxics Release Inventory and Right-to-Know Conference Proceedings, pp. 189-192 EPA/749-R-98-001. Washington, D.C.: U.S. Environmental Protection Agency.

62. Tryens, Jeffrey, Richard Schrader, and Paul Orum, undated. Making the Difference: Using the Right-to-Know in the Fight Against Toxics (Washington, DC: Center for Policy Alternatives and Working Group on Community Right-to-Know).

63. United Nations Environment Programme. 1997. Decision 19/13C. http://irptc.unep.ch/pops/gcpops_e.html. Accessed 7/7/98.

64. U.S EPA, 1998. National Water Quality Inventory: 1996 Report to Congress. EPA 841-F-97-003. Washington, DC: U.S. Environmental Protection Agency, Office of Water.

65. U.S. EPA. 1997. Deposition of Air Pollutants to the Great Waters: Second Report to Congress. EPA 453/R-97-011.Washington, DC: U.S. Environmental Protection Agency, Office of Air Quality.

66. U.S. EPA. 1996. "Toxics in the Great Lakes Basin: The Communities' Right to Know." Great Lakes Pollution Prevention Fact Sheets. http://www.epa.gov/glnpo/p2/factsh.html. Accessed 7/7/98.

67. U.S. EPA. 1995. Regulatory Impact Analysis of the Final Great Lakes Water Quality Guidance. Final Report Prepared for the U.S. Environmental Protection Agency, Office of Science and Technology by RCG/Hagler, Bailly, Inc., Boulder, CO.

68. U.S. EPA, 1993. State Directory: 33/50 and Voluntary Pollution Prevention Programs, 1993. (Washington, DC: U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances, October).

69. U.S. EPA. 1991. Great Lakes Basin Risk Characterization Study. Draft Report. Chicago, IL: U.S. Environmental Protection Agency Region V, Great Lakes National Program Office.

70. U.S. EPA and Environment Canada. 1997. The Great Lakes Binational Toxics Strategy: Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes. April 7, 1997.

71. U.S. GAO. 1991. Toxic Chemicals: EPA's Toxic Release Inventory Is Useful But Can Be Improved. GAO/RCED-91-121. Washington, DC: U.S. General Accounting Office.

72. Vining, Aidan R. and David L. Weimer, Information Asymmetry Favoring Sellers: A Policy Framework, *Policy Sciences* 21, 281-303, (1988).

73. Warren, G. 1993. Revised Whole-Basin Load Estimates for Critical Pollutants. Memorandum from Glenn Warren to Arnie Leder, March 4.

74. Wolf, S. 1996. “Fear and Loathing About the Public Right to Know: The Surprising Success of the Emergency Planning and Community Right-To-Know Act.” *Journal of Land Use & Envt’l Law* 11, Spring.

APPENDIX A
COMBUSTION

A.1 BACKGROUND

Since there are multiple chemicals that may be reported as a result of combustion activities, and since there are numerous facilities engaged in combustion, this appendix summarizes the analyses relating to combustion sources. The manufacturing and utility sectors are described separately.

Certain persistent bioaccumulative toxic (PBT) chemicals are found in fuels used by manufacturing facilities and electric utilities, or are created as a byproduct of the combustion process. These chemicals include mercury, vanadium, polycyclic aromatic compounds (PACs) including benzo(g,h,i)perylene, polychlorinated biphenyls (PCBs), and hexachlorobenzene. Although the concentration of these chemicals is often low per unit of fuel, facilities with sufficient annual throughput of fuel may exceed lower TRI reporting thresholds.

The following sections describe the process used to estimate the number of TRI reports that may be submitted at lower reporting thresholds for each of these chemicals, except vanadium and vanadium compounds, as a result of fuel combustion. The lower reporting thresholds considered were 1 pound, 10 pounds, 100 pounds, and 1,000 pounds per year of PBT chemical manufactured, processed, or otherwise used. It was also assumed that the current 0.1 percent or 1 percent *de minimis* exemption would not apply to the persistent and bioaccumulative chemicals present in various fuels. For vanadium and vanadium compounds, the number of reports expected at current reporting thresholds is estimated. In addition, the *de minimis* exemption will apply.

A.2 ESTIMATION OF REPORTING FOR MANUFACTURING FACILITIES

The approach used to estimate the number of manufacturing facilities (SIC codes 20-39) that are expected to exceed the lower TRI reporting thresholds as a result of fuel usage included the following steps:

1) Selection of typical concentrations for each PBT chemical in the various fuels;

2) Calculation of the minimum annual throughput of various fuels needed to exceed each of the lower thresholds;

3) Estimation of the percentage of manufacturing facilities that burn enough fuel to exceed the threshold for the particular chemical; and

4) Estimation of the total number of manufacturing facilities expected to submit reports at each of the lower reporting thresholds.

A description of the steps outlined above is provided in the following subsections.

A.2.1 TYPICAL CHEMICAL CONCENTRATIONS IN VARIOUS FUELS

Table A-1 shows the various fuels used by manufacturing facilities and utilities, the typical concentration of each PBT chemical, with the exception of vanadium, and the fuel amounts needed to exceed the lower reporting thresholds. A range of chemical concentrations is possible depending on the source of the fuel. Typical concentrations provided in the literature (American Petroleum Institute, 1994; Christman, 1980; EPA, 1997a; EPA, 1995; EPA, 1996; EPA, 1997b) were selected to obtain realistic estimates of additional reports.

TABLE A-1
ESTIMATED QUANTITY OF FUEL THROUGHPUT REQUIRED TO EXCEED LOWER REPORTING THRESHOLDS

Fuel Type	PBT Chemical	Concentration	Fuel Amounts to Exceed Lower Reporting Thresholds			
			1 lb	10 lbs	100 lbs	1,000 lbs
Coal (tons)	Vanadium[e]	0.024 lb/ton (3)	403,226[b]	403,226[b]	403,226[b]	403,226[b]
	Mercury	0.00042 lb/ton (12)	2,381	23,810	238,100	2,381,000
	PACs[a]	0.00052 lb/ton (11)	1,923	19,231	192,308	1,923,077
	Benzo(g,h,i)perylene	0.0000099 lb/ton (11)	101,010	1,010,100	10,101,000	101,010,100
	Hexachlorobenzene	0.00000168 lb/ton (9,13)	595,200	5,952,000	59,523,800	595,238,000
Residual Fuel Oil (barrels)	PACs[a]	0.19 lbs/bbl (1)	5	53	530	5,303
	PCBs[d]	0.0165 lbs/bbl (14)	60	605	6,045	60,451
	Vanadium[e]	0.0013 lbs/bbl (10)	7,372,283[b]	7,372,283[b]	7,372,283[b]	7,372,283[b]
	Mercury	0.00000165 lbs/bbl (13)	604,507	6,045,065	60,450,654	604,506,541
	Benzo(g,h,i)perylene	0.000000095 lb/bbl (10)	10,535,188	105,351,875	1,053,518,753	10,535,187,526
Distillate Fuel Oil (Barrels)	Mercury	0.00012 lbs/bbl (12)	8,440	84,395	843,954	8,439,539
	Vanadium[e]	0.00018 lbs/bbl (2)	55,216,892[b]	55,216,892[b]	55,216,892[b]	55,216,892[b]
	Benzo(g,h,i)perylene	0.000015 lbs/bbl (1)	67,516	675,163	6,751,631	67,516,315
	PACs[a]	0.0013 lbs/bbl (1)	754	7,544	75,437	754,372
Natural Gas	Vanadium[e]	0.33 ppm[b] (10)	1,213,480,310[b]	1,213,480,310[b]	1,213,480,310[b]	1,213,480,310[b]
Wood (tons)	PACs[a]	0.000084 lb/ton (11)	11,905	119,048	1,190,476	11,904,762
	Benzo(g,h,i)perylene	0.000007 lb/ton (11)	142,860	1,428,600	14,286,000	142,860,000

(a) Includes benz(a)anthracene, chrysene and benzo(a)pyrene. American Petroleum Institute, 1994.
(b) Adjusted to account for formation of the metal oxide.
(c) Note: due to rounding, calculations may not yield exact numbers.
(d) Note: only 10 percent of residual oil assumed to be contaminated at 50 ppm maximum.
(e) Under the final rule vanadium will be reported on at the current thresholds. Because vanadium is present below the *de minimis* concentration when fuels are otherwise used only the manufacture of vanadium will result in reports. Fuel amounts listed in the table reflect amounts that will exceed the 25,000 lb manufacture threshold.

A.2.2 FUEL USAGE REQUIRED TO EXCEED REPORTING THRESHOLDS

Once the concentration of a toxic chemical in a fuel is determined, estimating the amount of fuel required to exceed a reporting threshold is straightforward, requiring a simple set of calculations. Table A-2 provides a list of conversion factors used in the calculations throughout this appendix.

TABLE A-2
CONVERSION FACTORS USED TO CALCULATE
FUEL THROUGHPUTS

Parameter	Calculation Data
Density of Residual Oil (16):	7.88 lbs/gallon (0.946 kg/L)
Density of Distillate Oil (16):	7.05 lbs/gallon (0.847 kg/L)
Energy Content of Distillate Oil (5):	139,000 Btu/gallon
Ton:	2,000 lbs
Barrel:	42 gallons (petroleum, U.S.)
Kilogram:	2.2 pounds
Gallon:	3.785 liters
1 ppm (solid):	1 mg/kg
1 ppm (liquid):	1 mg/L
1 ppm (gas):	1 microgram/cubic meter
1 microgram/cubic meter:	62.43×10^{-9} lbs/1,000 cubic feet

As an example, the following calculation shows the procedure used to estimate the amount of each fuel needed to reach the lower reporting thresholds for mercury, based on typical mercury concentrations of 0.21 ppm in coal, 0.005 ppm in residual oil, and 0.4 ppm in distillate oil (equivalent to the values shown in Table A-1), and densities of 7.88 lbs/gallon (equivalent to 0.946 kg/L) for residual oil and 7.05 lbs/gallon (equivalent to 0.847 kg/L) for distillate oil.

Coal (tons):
1 lb threshold: (1,000,000 mg/kg) × (1/0.21 mg/kg) × (1 ton/2,000 lbs) = 2,381 tons coal
10 lb threshold: 2,381 tons coal × 10 = 23,810 tons coal
100 lb threshold: 2,381 tons coal × 100 = 238,100 tons coal
1,000 lb threshold: 2,381 tons coal × 1,000 = 2,381,000 tons coal

Residual Oil (barrels)

1 lb threshold: ((1lb/2.2 lb/kg) × 1,000,000 mg/kg)/(0.005 mg/kg × 0.946 kg/L) X (1 gal/3.785 L) × (1 barrel/42 US gallons) = 604,507 barrels

10 lb threshold: 604,507 × 10 = 6,045,070 barrels

100 lb threshold: 604,507 × 100 = 60,450,700 barrels

1,000 lb threshold: 604,507 × 1,000 = 604,507,000 barrels

Distillate Oil (barrels)

1 lb threshold: ((1lb/2.2 lb/kg) × 1,000,000 mg/kg)/(0.4 mg/kg × 0.847 kg/L) x (1 gal/3.785 L) × (1 barrel/42 US gallons) = 8,440 barrels

10 lb threshold: 8,440 × 10 = 84,400 barrels

100 lb threshold: 8,440 × 100 = 844,000 barrels

1,000 lb threshold: 8,440 × 1,000 = 8,440,000 barrels

For vanadium, combustion results in the manufacture of vanadium pentoxide (VO_5). Since the metal oxide is heaver than the parent metal, the manufacturing threshold for metal compounds will be exceeded before the otherwise use threshold for the parent metal (i.e., less fuel is required to reach the threshold for the metal compound as compared to the parent metal). To estimate the amount of each fuel type required to reach the current thresholds, a factor was applied to the calculation to account for the manufacture of metal oxides. For vanadium, the factor is 0.39 based on 50.94 V/130.94 VO_5.

For hexachlorobenzene (HCB), an estimated emission factor was derived using the total estimated HCB releases from coal-fired utility boilers in 1990 (1,360 pounds) (EPA, 1997a) and the amount of coal burned by electric utilities in SIC code 4911 (807,536,103 tons) (EPA, 1997c). Since the amount of coal used was not available for electric utilities in SIC codes 4931 and 4939, the calculated emission factor (0.00000168 lbs HCB/ton coal) is larger than would be calculated if the additional coal information were known. Therefore, the estimated number of manufacturing facilities in SIC codes 20-39 and the number of electric utilities in SIC code 49 is expected to be an overestimate.

A.2.3 PERCENTAGE OF FACILITIES MEETING THE MINIMUM FUEL REQUIREMENTS

To determine the percentage of manufacturing facilities burning sufficient fuel to exceed the 1-, 10-, 100-, 1,000-, 10,000-, and 25,000-lb/yr reporting thresholds, the Industrial Combustion Coordinated Rulemaking (ICCR) database created by EPA in 1998 was used. The ICCR database is a combustion unit inventory database that contains information on industrial and commercial combustion sources. The ICCR database includes information from EPA and state electronic databases, most importantly the EPA Aerometric Information Retrieval System (AIRS) and the Ozone Transport Assessment Group (OTAG) databases. In addition, 17 state databases were merged into the ICCR database. In merging these various databases, care was given not to enter duplicate records for any facility or combustion unit.

The ICCR database does not include information to determine the precise amount of fuel throughput for every facility. While approximately 60 percent of the boiler-specific records

contain a fuel flow rate or operating rate that can be used as a fuel throughput, the other 40 percent do not have this information. For records without flow rate or operating rate information, fuel throughput was estimated using the design capacity and operating hours. Since approximately 20 percent of boilers in the ICCR database burn multiple fuels, individual fuel throughput is overestimated for these records. The fuel throughputs for each boiler at a given facility burning a given fuel type were summed to determine the facility level fuel usage in a given fuel type. Table A-3 summarizes the ICCR information for manufacturing facilities, including maximum fuel throughput and the number of facilities by decile. Using the ICCR data and the fuel throughput information in Table A-1, the percentage of facilities using the minimum fuel throughput needed to exceed each reporting threshold was calculated. The percentage was calculated by counting the number of facilities with annual fuel throughputs greater than the minimum and dividing by the total number of facilities. Table A-4 summarizes the percentage of facilities exceeding each reporting threshold by fuel type and chemical.

TABLE A-3
FUEL THROUGHPUT OF MANUFACTURING FACILITIES (15)

	Coal (tons)		Distillate Oil (barrels)		Residual Oil (barrels)		Wood (tons)		Natural Gas (MMCF)	
Decile	Maximum Throughput	Number of Facilities	Maximum Throughput	Number of Facilities	Maximum Throughput	Number of Facilities	Maximum Throughput	Number of Facilities	Maximum Throughput	Number of Facilities
0	2,540,304	68	17,937,143	262	11,033,244	212	7,356,002	140	613,330	924
1	139,170	68	104,836	262	215,467	212	153,921	140	962	924
2	69,855	68	50,139	262	105,595	213	55,787	140	458	924
3	39,900	68	19,739	262	63,556	213	27,894	140	231	924
4	24,393	68	8,205	262	35,200	213	18,537	140	104	924
5	15,470	68	3,646	262	17,690	213	13,283	141	54.3	925
6	7,014	68	1,405	263	9,119	213	6,833	141	30.7	925
7	2,218	68	548	263	3,929	213	3,213	141	13.7	925
8	388	68	187	263	976	213	1,300	141	3.6	925
9	25	69	21	263	36	213	103	141	0.017	925
	Total:	**681**	**Total:**	**2,624**	**Total:**	**2,128**	**Total:**	**1,405**	**Total:**	**9,245**

A.2.4 TOTAL NUMBER OF MANUFACTURING FACILITIES SUBJECT TO TRI USING VARIOUS FUELS

To determine the number of facilities that burn sufficient fuel to reach each threshold, the percentage of facilities burning the minimum amount of fuel, determined from the ICCR database (EPA, 1998) (Table A-4), was applied to the total number of facilities using each fuel obtained from the 1994 Manufacturing Energy Consumption Survey (MECS), which is conducted every four years by the Energy Information Administration of the Department of Energy. The MECS information was used rather than the ICCR information in order to account for the number of facilities with greater than 10 employees. Table A-5 shows the total number of manufacturing facilities using various fuel types. The first column on the table shows the total number of facilities reporting the use of the fuel. As some facilities use more than one fuel, summing the number of facilities across fuel types results in some overcounting of facilities. MECS does not contain information for wood waste combustion. The total number of facilities in the ICCR database reporting wood combustion was used instead.

The total number of facilities reporting any on-site energy generation is approximately 247,000 (DOE, 1997). The total number of facilities in SIC codes 20-39 with more than 10 employees is approximately 185,000 (Bureau of Census, 1995). This indicates that about 25 percent of the facilities reporting under MECS have fewer than 10 employees. Facilities with fewer than 10 employees are not be required to report to under EPCRA Section 313. Therefore, the total number of facilities shown in the second column of Table A-5 have been reduced by 25 percent.

Since TRI reporting exempts fuel usage for employee personal use (heating, lighting, ventilation) and for motor vehicles from reporting threshold calculations, the number of facilities shown in Table A-5 have also been reduced by applying factors to account for non-process fuel usage. The percentage of process and non-process fuel use and the total fuel use was obtained from MECS:

	Coal (1,000 tons)	**Residual Oil (1,000 bbl)**	**Distillate Oil (1,000 bbl)**	**Natural Gas (billion cu ft)**
Total Fuel	54,143	70,111	26,107	5,962
Non-Process Fuel	378	2,197	8,349	705
% Non-Process	1%	3%	32%	12%

TABLE A-4
PERCENTAGE OF MANUFACTURING FACILITIES WITH FUEL COMBUSTION ACTIVITIES THAT EXCEED THE 1-, 10-, 100-, 1,000-POUND THRESHOLDS BY FUEL TYPE AND PBT CHEMICAL

Fuel Type and PBT Chemical	% of Facilities Exceeding the Lower Thresholds			
	1 lb	10 lbs	100 lbs	1,000 lbs
Coal				
Mercury	70	40.4	5.4	0.2
Vanadium[a]	2.9	2.9	2.9	2.9
PACs	70.8	45.2	7.2	0.3
Hexachlorobenzene	1.5	0	0	0
Benzo(g,h,i)perylene	14.4	0.6	0	0
Residual Fuel Oil				
Mercury	2.8	0.1	0	0
Vanadium[a]	0.05	0.05	0.05	0.05
PCBs	82.6	65.7	30.8	2.8
PACs	94.5	89.1	83	67.1
Benzo(g,h,i)perylene	0.05	0	0	0
Distillate Fuel Oil				
Mercury	39.6	12.4	1.2	0.1
Vanadium	0	0	0	0
PACs	66.8	41.4	15.05	1.3
Benzo(g,h,i)perylene	16	1.5	0.08	0
Natural Gas				
Vanadium[a]	0	0	0	0
Wood				
PACs	52.6	12.1	0.6	0
Benzo(g,h,i)perylene	10.3	0.5	0	0

(a) Under the final rule vanadium will be reported on at the current thresholds. Because vanadium is present below the *de minimis* concentration when fuels are otherwise used, only the manufacture of vanadium will result in reports. Percents of facilities listed in the table reflect the percent of facilities that will exceed the 25,000 lb manufacture threshold.

Using the adjusted total number of facilities shown in Table A-5, and applying the percentages shown in Table A-4, the total number of facilities meeting the various thresholds was determined. Table A-6 shows the number of facilities exceeding the lower reporting thresholds for each chemical and fuel type. The total number of TRI reports expected at each threshold for each chemical associated with fuel combustion is provided at the bottom of the table.

TABLE A-5
NUMBER OF MANUFACTURING FACILITIES USING VARIOUS FUEL TYPES

Fuel Type	Total Number of Facilities	Estimated Number of Facilities With More Than 10 Employees[a]	Process Use/Exempt Use Adjustment Factor	Estimated Number of Facilities Subject to Reporting for Combustion
Coal	1,144	858	99%	849
Residual Oil	2,992	2,244	97%	2,177
Distillate Oil	35,920	26,940	68%	18,319
Natural Gas	158,775	119,081	88%	104,791
Wood	1,405	1,054	NA	1,054

Note: Due to rounding, calculations may not yield exact numbers.
(a) Number of total facilities decreased by 25% to account for those with less than 10 employees.

TABLE A-6
NUMBER OF MANUFACTURING FACILITIES
EXCEEDING THE LOWER REPORTING THRESHOLDS

	Vanadium	Mercury				PACs			
Fuel Type	**25,000 lbs**	**1 lb**	**10 lbs**	**100 lbs**	**1,000 lbs**	**1 lb**	**10 lbs**	**100 lbs**	**1,000 lbs**
Coal	25	594	343	46	2	601	384	61	3
Residual Oil	1	61	2	0	0	2,057	1,940	1,807	1,461
Distillate Oil	NA	7,254	2,272	220	18	12,237	7,584	2,757	238
Natural Gas	0	NA	NA	NA	NA	NA	NA	NA	NA
Wood	NA	NA	NA	NA	NA	554	128	6	0
Total Facilities:	**26**	**7,909**	**2,617**	**266**	**20**	**15,449**	**10,036**	**4,631**	**1,702**

	Benzo(g,h,i)perylene				PCBs				HCB			
Fuel Type	**1 lb**	**10 lbs**	**100 lbs**	**1,000 lbs**	**1 lb**	**10 lbs**	**100 lbs**	**1,000 lbs**	**1 lb**	**10 lbs**	**100 lbs**	**1,000 lbs**
Coal	122	5	0	0	NA	NA	NA	NA	13	0	0	0
Residual Oil	1	0	0	0	1,798	1,430	671	61	NA	NA	NA	NA
Distillate Oil	2,931	275	15	0	NA	NA	NA	NA	NA	NA	NA	NA
Natural Gas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wood	109	5	0	0	NA	NA	NA	NA	NA	NA	NA	NA
Total Facilities:	**3,163**	**285**	**15**	**0**	**1,798**	**1,430**	**671**	**61**	**13**	**0**	**0**	**0**

Note: Due to rounding, calculations may not yield exact numbers.

A.3 ESTIMATION OF REPORTING FROM ELECTRIC UTILITIES

Coal- and oil-burning establishments in the following sectors engage in the generation, transmission, and distribution of electricity, gas, or steam, that are subject to TRI reporting:

- Electric Services (SIC code 4911);
- Electric and Other Services Combined (SIC code 4931); and
- Combination Utilities, Not Otherwise Classified (SIC code 4939).

References to coal and oil facilities in this appendix refer specifically to facilities that burn coal or oil in the production of electricity for distribution in commerce.

For this analysis, electric utility facilities were grouped according to their primary fuel type. The analysis considered 390 coal, 124 oil, and 49 combined cycle electric utility facilities in SIC code 4911 (EPA, 1997c). The analysis also considered 197 coal-fired and 98 oil-fired facilities in SIC code 4931, and 19 coal fired and 14 oil fired facilities in SIC code 4939.

The estimated number of facilities in SIC Code 4911 exceeding the thresholds for the combustion-related PBT chemicals was determined by calculating the total pounds of each chemical manufactured at each facility using throughput information for all fuels combusted at each facility and the chemical concentration data presented in Table A-2. Although facilities were grouped by primary fuel type, most facilities utilize more than one fuel type. This approach accounts for chemicals manufactured due to the combustion of all fuel types at each facility.

To estimate the number of facilities in SIC codes 4931 and 4939, the percentage of facilities in SIC code 4911 exceeding each threshold was applied to the number of facilities in SIC codes 4931 and 4939 by fuel type. The total number and percentage of facilities in SIC code 4911 exceeding each threshold is presented by fuel type and PBT chemical in Table A-7. The number of oil and coal burning facilities by SIC code, and the total number of facilities predicted to report at each threshold for all chemicals associated with combustion are provided in Table A-8.

A.4 SUMMARY

Table A-9 summarizes the number of facilities expected to report at various thresholds for each persistent and bioaccumulative chemical related to combustion. For all chemicals, the expected number of reports decreases as the reporting threshold increases.

TABLE A-7
PERCENTAGE OF FACILITIES IN SIC CODE 4911 EXCEEDING THE LOWER THRESHOLDS

	Vanadium	Mercury				PACs			
	25000	1lb	10 lbs	100 lbs	1,000 lbs	1lb	10 lbs	100 lbs	1,000 lbs
Coal Combustion									
Total Number of Facilities Combusting Coal	390	390	390	390	390	390	390	390	390
Total Number Exceeding the Threshold	294	388	385	328	122	390	387	361	250
Percentage of Facilities Exceeding the Threshold	75.4%	99.5%	98.7%	84.1%	31.3%	100.0%	99.2%	92.6%	64.1%
Oil Combustion									
Total Number of Facilities Combusting Oil	124	124	124	124	124	124	124	124	124
Total Number Exceeding the Threshold	1	32	3	0	0	124	122	104	86
Percentage of Facilities Exceeding the Threshold	0.8%	25.8%	2.4%	0.0%	0.0%	100.0%	98.4%	83.9%	69.4%

	Benzo(g,h,i)perylene				PCBs				HCB			
	1lb	10 lbs	100 lbs	1,000 lbs	1lb	10 lbs	100 lbs	1,000 lbs	1lb	10 lbs	100 lbs	1,000 lbs
Coal Combustion												
Total Number of Facilities Combusting Coal	390	390	390	390	390	390	390	390	390	390	390	390
Total Number Exceeding the Threshold	363	220	4	0	244	170	29	7	263	22	0	0
Percentage of Facilities Exceeding the Threshold	93.0%	56.0%	1.0%	0.0%	62.6%	43.6%	7.4%	1.8%	67.0%	6.0%	0.0%	0.0%
Oil Combustion												
Total Number of Facilities Combusting Oil	124	124	124	124	124	124	124	124	NA	NA	NA	NA
Total Number Exceeding the Threshold	0	0	0	0	104	82	66	32	NA	NA	NA	NA
Percentage of Facilities Exceeding the Threshold	0.0%	0.0%	0.0%	0.0%	83.9%	66.1%	53.2%	25.8%	NA	NA	NA	NA

Note: Due to rounding, calculations may not yield exact numbers.

TABLE A-8
TOTAL NUMBER OF FACILITIES IN SIC 4911, 4931, AND 4939
EXCEEDING THE LOWER THRESHOLDS

Electric Utility Description	Vanadium	Mercury				PACs			
	25,000 lbs	1lb	10 lbs	100 lbs	1,000 lbs	1lb	10 lbs	100 lbs	1,000 lbs
Coal Combustion (SIC Code 4911)	294	388	385	328	122	390	387	361	250
Oil Combustion (SIC Code 4911)	1	32	3	0	0	124	122	104	86
Coal Combustion (SIC Code 4931)	149	196	195	166	62	197	196	183	126
Oil Combustion (SIC Code 4931)	1	25	2	0	0	98	96	82	68
Coal Combustion (SIC Code 4939)	14	19	19	16	6	19	19	18	12
Oil Combustion (SIC Code 4939)	0	4	0	0	0	14	14	11	10
Totals Electric Utilities:	**459**	**664**	**604**	**510**	**190**	**842**	**834**	**759**	**552**

Electric Utility Description	Benzo(g,h,i)perylene				PCBs				HCB			
	1lb	10 lbs	100 lbs	1,000 lbs	1lb	10 lbs	100 lbs	1,000 lbs	1lb	10 lbs	100 lbs	1,000 lbs
Coal Combustion (SIC Code 4911)	363	220	4	0	244	170	29	7	263	22	0	0
Oil Combustion (SIC Code 4911)	0	0	0	0	104	82	66	32	0	0	0	0
Coal Combustion (SIC Code 4931)	183	111	2	0	123	86	15	4	133	11	0	0
Oil Combustion (SIC Code 4931)	0	0	0	0	82	65	52	25	0	0	0	0
Coal Combustion (SIC Code 4939)	18	11	0	0	12	9	2	0	13	1	0	0
Oil Combustion (SIC Code 4939)	0	0	0	0	12	9	7	4	0	0	0	0
Totals Electric Utilities:	**564**	**342**	**6**	**0**	**577**	**421**	**171**	**72**	**409**	**34**	**0**	**0**

Note: Due to rounding, calculations may not yield exact numbers.

TABLE A-9
SUMMARY OF COMBUSTION-RELATED TRI REPORTS AT LOWER THRESHOLDS - SIC Codes 20-39, 4911, 4931, and 4939

Chemical	Number of Facilities Expected to Report at Each Threshold			
	1 lb	10 lbs	100 lbs	1,000 lbs
Vanadium[a]	485	485	485	485
Mercury	8,573	3,221	776	210
PACs	16,291	10,870	5,390	2,254
Hexachlorobenzene	422	34	0	0
Benzo(g,h,i)perylene	3,727	627	21	0
PCBs	2,375	1,851	842	133

(a) Under the final rule, vanadium will be reported on at current thresholds. Because vanadium is present below the *de minimis* concentration when fuels are otherwise used, only the manufacture of vanadium will result in reports. Numbers of facilities listed in the table reflect the number of facilities that will exceed the 25,000 lb manufacture threshold.

LITERATURE CITED

1. American Petroleum Institute (1994). Transport and Fate of non-BTEX Petroleum Chemicals in Soil and Groundwater. Prepared by Arthur D. Little, Inc. Cambridge, MA.

2. Cao, J.R. (1992). Microwave Digestion of Crude Oils and Oil Products for the Determination of Trace Materials and Sulphur by Inductively-Coupled Plasma Atomic Emission Spectroscopy, Environment Canada.

3. Christman, R.C., J. Haslbeck, B. Sedlik (1980). Activities, Effects and Impacts of the Coal Fuel Cycle for a 1,000-MWe Electric Power Generating Plant. Prepared for U.S. Nuclear Regulatory Commission.

4. ERG and U.S. EPA's Region V Office (1998). Teleconference on PCB Usage in SIC Codes 20-39, June 12.

5. PECO Energy's Gas Transport Service — Conversion Tables. Http://www.pecogas.com/tables.htm

6. Perry & Green (1984). Perry's Chemical Engineers Handbook, Sixth Edition. McGraw-Hill Publishers.

7. U.S. Department of Commerce, Bureau of the Census (1995). 1995 County Business Patterns. CBP/95-1.

8. U.S. Department of Energy (1997). Manufacturing Consumption of Energy 1994; Energy Information Administration. DOE/EIA-0512.

9. U.S. EPA (1997a). 1990 Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)/ 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. U.S. EPA, Emissions, Monitoring and Analysis Division, Emissions Factor and Inventory Group and Air Quality Strategies and Standards Division, Visibility and Ecosystem Protection Group.

10. U.S. EPA (1995). Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Sources.

11. U.S. EPA (1998). Locating and Estimating Air Emissions from Sources of Polycyclic Organic Material. Office of Air Quality and Standards. EPA-454/R-98-014. July.

12. U.S. EPA (1997b). Locating and Estimating Air Emissions from Sources of Mercury and Mercury Compounds. Office of Air Quality Planning and Standards.

13. U.S. EPA (1997c). Economic Analysis of the Final Rule to Add Certain Industries to EPCRA Section 313. Office of Pollution Prevention and Toxics.

14. U.S. EPA (1997d). Management of Polychlorinated Biphenyls in the United States. Office of Pollution Prevention and Toxics.

15. U.S. EPA (1998). Industrial Combustion Coordinated Rulemaking (ICCR) Database, Version 3. http://www.epa.gov/ttnuatw1/combust/iccrarch/general.html

16. U.S. EPA (1999). http://www.epa.gov/ttn/chief/ap42pdf/appa.pdf

APPENDIX B
DIOXIN AND DIOXIN-LIKE COMPOUNDS

B.1 INTRODUCTION

Dioxins and furans are two related classes of organochlorine compounds that include polychlorinated dibenzo-*p*-dioxins (PCDDs or CDDs) and polychlorinated dibenzo-furans (PCDFs or CDFs). There are 75 congeners, or individual compounds, of CDDs and 135 congeners of CDFs (U.S. EPA, 1998). Of these 210 congeners, seven CDD congeners and ten CDF congeners are thought to exhibit some degree of toxicity. These 17 congeners all have four chlorine atoms attached to the main dioxin or furan molecule in the 2, 3, 7, and 8 positions. For risk assessment purposes, the term "dioxin" often refers to the 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) congener. 2,3,7,8-TCDD is the most widely studied congener and is considered to be the most toxic of the dioxins and furans (U.S. EPA, 1998)[1].

B.2 TOXICITY EQUIVALENCE FACTORS

Because CDD/CDF congeners have different toxicities and are often found together in complex mixtures, a toxicity equivalence procedure was devised to describe the cumulative toxicity of the CDD/CDF congener mixtures (U.S. EPA, 1998). The toxicity equivalence factor (TEF) describes the toxicity of a congener relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1. The toxicity equivalence factors (TEF) shown in Table B-1 have been adopted by international convention (U.S. EPA, 1998). The toxic equivalence (TEQ) of a CDD/CDF mixture is calculated by multiplying the mass or concentration of individual congeners by their respective TEFs and summing them together. Conversely, if congener-specific data are provided, grams TEQ can be converted into total grams. The data from the 1998 Dioxin Inventory are presented in grams of toxic equivalency per year.

[1]This appendix relies heavily on data from the 1998 draft report, *The Inventory of Sources of Dioxin in the United States* and its accompanying CD-ROM (U.S. EPA, 1998). The EPA's Office of Research and Development (ORD) developed the 1998 Dioxin Inventory and accompanying CD-ROM as a part of ORD's continued effort to assess exposure to, and the health effects associated with, dioxins and furans.

TABLE B-1
TOXICITY EQUIVALENCE FACTORS (TEF) FOR CDDS AND CDFS

Dioxin Congener	TEF	Furan Congener	TEF
2,3,7,8-TCDD	1	2,3,7,8-TCDF	0.1
1,2,3,7,8-PCDD	0.5	1,2,3,7,8-PCDF	0.05
1,2,3,4,7,8-HxCDD	0.1	2,3,4,7,8-PCDF	0.5
1,2,3,6,7,8-HxCDD	0.1	1,2,3,4,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDD	0.1	1,2,3,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDD	0.01	1,2,3,7,8,9-HxCDF	0.1
1,2,3,4,6,7,8,9-OCDD	0.001	2,3,4,6,7,8-HxCDF	0.1
		1,2,3,4,6,7,8-HpCDF	0.01
		1,2,3,4,7,8,9-HpCDF	0.01
		1,2,3,4,6,7,8,9-OCDF	0.001

Source: U.S. EPA, 1998

B.3 FORMATION

Dioxins and furans are formed as unwanted byproducts when chlorinated materials are involved in combustion or other high-temperature processes, such as waste incineration, metallurgical processes, and fossil fuel and wood combustion. CDD/CDF formation from combustion processes can be explained by three main theories which are not mutually exclusive. The first theory is that the feed material to the combustion process already contains CDD/CDFs; they survive the combustion process and are emitted from the stack. According to the second theory, CDD/CDFs are formed from the thermal breakdown and molecular rearrangement of precursor compounds which have a structure similar to CDD/CDF molecules. The third theory is that CDD/CDFs are formed from non-precursors which are not similar to the CDD/CDF molecular structure. In this theory, precursors are not present in the feed material; it is the combustion of diverse non-precursors in the presence of a chlorine donor that react to form precursors and then CDD/CDFs (U.S. EPA, 1994a).

Dioxins and furans are also unintentionally formed in certain industrial processes involving chlorine, such as pulp and paper bleaching or the manufacture of chlorinated phenols (U.S. Dept. of Health and Human Services, 1997).

B.4 PRODUCTION

Dioxins and furans are not commercially produced in the United States except in small quantities for chemical analyses and toxicological research. The only two reported commercial producers of dioxins are Eagle Picher Industries, Inc. in Lenexa, Kansas, and Cambridge Isotope Laboratories in Andover, Massachusetts. CDD/CDFs are not imported or exported from the United States unless as trace contaminants in a product (U.S. Dept. of Health and Human Services, 1997).

Potential sources of CDD/CDF releases include combustion sources, metallurgical processes, chemical manufacturing and industrial processes, and reservoir sources. Table B-2 presents the source categories for CDD/CDFs and the release estimates from the 1998 Dioxin Inventory. It should be emphasized that the release estimates are not necessarily equivalent to the amounts of CDD/CDFs manufactured, processed, or otherwise used because of the chemistry of dioxin formation and destruction within the combustion process. For example, dioxins that are manufactured during combustion may also be destroyed by combustion prior to release.

In terms of grams TEQ, the three largest sources of CDD/CDF releases are municipal solid waste incinerators, secondary copper smelters, and medical waste incinerators, generating air emissions that account for 37 percent, 18 percent, and 16 percent of all CDD/CDF releases in 1995, respectively. Forest, brush, and straw fires, the largest natural source of CDD/CDFs, released an estimated 7 percent (g TEQ) of all CDD/CDFs in 1995 (U.S. EPA, 1998).

TABLE B-2
1995 DIOXIN AND FURAN EMISSIONS INVENTORY FOR THE UNITED STATES

Source Categories (SIC Code)	1995 Releases[a] (g TEQ/year)	Percent of Total
Municipal solid waste incinerators, to air (4953)	1,100	37%
Secondary copper smelting, to air (3341)	541	18%
Medical waste incinerators, to air (4953)	477	16%
Forest, brush, and straw fires, to air	208	7%
Municipal sludge (non-incinerated), to land	207	7%
Cement kilns (hazardous waste), to air (3241)	153	5%
Industrial/utility coal combustion, to air	73	2%
Residential wood burning, to air	63	2%
Vehicle fuel combustion, to air	40	1%
Industrial wood combustion, to air	29	1%
Bleached chemical pulp and paper mills, to water (2611, 2621)	20	0.7%
Cement kilns (nonhazardous waste), to air (3241)	18	0.6%
Secondary aluminum smelters, to air (3341)	17	0.6%
Industrial/utility oil combustion, to air	9	0.3%
Sewage sludge incineration, to air (4953)	6	0.2%
Hazardous waste incineration, to air (4953)	6	0.2%
Kraft black liquor recovery boilers, to air (2611)	2	<0.1%
Secondary lead smelters, to air (3341)	2	<0.1%
Pulp and paper mill sludge, to land (2611, 2621)	1	<0.1%
Cigarette smoke, to air	1	<0.1%
Boilers and industrial furnaces, to air	<1	<0.1%
Crematoria, to air (7621)	<1	<0.1%
Total	**2,974**	**100%**

Source: U.S. EPA, 1998

[a]All estimates represent central values. Uncertainty ranges around these central estimates vary from a factor of 5 to 10.

Dioxin and furan releases declined by 75 percent from 1987 to 1995. The two largest reductions were from municipal solid waste incinerators, which reduced emissions by 86 percent, and medical waste incinerators, which reduced emissions by 81 percent. Reductions were achieved through improved combustion processes and emission controls, and the closing of a number of facilities with high emissions (U.S. EPA, 1998).

The main source categories for CDD/CDFs are described in more detail below. The sources describe industrial and other processes that result in CDD/CDF releases. Not all of these source categories are subject to reporting under EPCRA section 313. Only processes that are conducted at facilities subject to EPCRA 313 are reportable under the Toxic Release Inventory (TRI).

B.4.1 COMBUSTION SOURCES

Waste Incineration

Waste incineration decreases the volume of waste by destroying solid, liquid, and gaseous wastes through the application of heat (U.S. EPA, 1998). Waste incineration includes the following sources of potential CDD/CDF releases: municipal waste incineration, medical waste incineration, hazardous waste incineration, and boilers and industrial furnaces that burn hazardous waste. Other potential sources include sewage sludge incineration, crematoria, tire combustion, pulp and paper mill sludge incineration, and biogas combustion. The vast majority of CDD/CDFs releases from waste incineration sources are emitted to air (U.S. EPA, 1998). Among the waste incineration sources, hazardous waste incineration and pulp and paper mill sludge incineration may be conducted at facilities that are subject to TRI reporting.

Energy Generation

Energy generation sources of CDD/CDF releases include the combustion of coal, oil, and wood in residential, industrial, and electric utility establishments. Industrial combustion of these fuels occurs in all of the manufacturing sectors.

CDD/CDFs are also formed during the combustion of vehicle fuel in both diesel and gasoline engines. Additives to fuel or oil (e.g., dichloroethane or pentachlorophenate) may act as a chlorine source to generate CDD/CDFs during incomplete combustion. The vast majority of CDD/CDFs releases from energy generation sources are emitted to air (U.S. EPA, 1998). Among the energy generation sources, industrial boilers and electric utilities fired by coal, oil, and wood may be located at facilities that are subject to TRI reporting.

Other High-Temperature Sources

CDD/CDFs may also be released by other types of incineration and high-temperature sources. Portland cement is the major type of cement produced in the United States. Pyroprocessing, an important process step in Portland cement kilns, may be a source of

CDD/CDF emissions (U.S. EPA, 1997a). Cement kilns can also burn hazardous waste. Of 212 cement kilns, 34 (16 percent) burned hazardous waste in 1995 (U.S. EPA, 1998).

The kraft process is a common method used in pulp mills for manufacturing pulp (U.S. EPA, 1995). Pulp mills recover beneficial chemicals from the spent liquor (black liquor) that is generated during the kraft process. The black liquor, which contains 0.5 to 4 percent chlorides by weight, undergoes combustion in kraft black liquor recovery boilers where CDD/CDFs may be formed (U.S. EPA, 1998).

Dioxins and furans may also be released from other combustion sources, including asphalt mixing plants, catalyst regeneration at petroleum refineries, carbon reactivation furnaces, cigarette smoking, and the pyrolysis of brominated flame retardants. In addition, minimally controlled or uncontrolled combustion sources may emit CDD/CDFs, including the combustion of landfill gas in flares, accidental fires in buildings and vehicles, landfill fires, agricultural burning, forest and brush fires, backyard trash burning, and the accidental combustion of polychlorinated biphenyls (U.S. EPA, 1998). The vast majority of CDD/CDFs releases from these other combustion sources are emitted to air (U.S. EPA, 1998).

The high-temperature sources that may be located at facilities subject to TRI reporting include cement kilns (both hazardous and non-hazardous waste burning), kraft black liquor recovery boilers, asphalt mixing plants, catalyst regeneration at petroleum refineries, and carbon reactivation furnaces. However, it is not clear if petroleum refineries with catalyst regeneration and asphalt mixing plants have sufficient information to develop reasonable throughput or release estimates. Therefore, EPA is not able to estimate the extent of reporting from these sources. CDD/CDF emissions from carbon reactivation furnaces were estimated to be negligible (U.S. EPA, 1998).

B.4.2 METALLURGICAL PROCESSES

Ferrous Sources

Metallurgical processes that may release CDD/CDFs include certain process steps in iron and steelmaking such as iron ore sintering, coke production, and producing steel in electric arc furnaces (EAF) from scrap feed. Iron ore undergoes sintering to facilitate processing in the blast furnace. Coke is produced from coal and is the principal fuel in iron and steelmaking. Testing of CDD/CDFs from U.S. sinter plants and coke plants has not been reported, but CDD/CDF emissions from plants in Europe have been reported in European investigations. Typically, the input feed for producing steel in EAFs is 100 percent scrap. EAFs have the potential to emit CDD/CDFs because the iron and steel scrap feed may contain chlorinated solvents, plastics, and cutting oils (U.S. EPA, 1998).

CDD/CDFs may also be emitted by ferrous foundries where iron and steel castings are often produced from scrap feed. Ferrous foundries have the same potential to emit CDD/CDFs as EAFs because of the similar composition of the scrap feed for both processes (U.S. EPA, 1998). The majority of CDD/CDFs releases from ferrous metal smelting and refining sources are emitted

to air, but emissions to water and land may occur as well (U.S. EPA, 1998). Ferrous sources that may be located at facilities subject to TRI reporting include iron ore sintering, coke production, and steel production in electric arc furnaces and ferrous foundries. However, as described in section B.4.5, insufficient data on CDD/CDF emissions from these source categories make it difficult to estimate the number of TRI reports from these source categories, and some facilities may have insufficient information to report.

Nonferrous Sources

Secondary nonferrous metal smelting involves the recovery of nonferrous metals and alloys from new and used scrap. Secondary aluminum, copper, and lead smelters are potential sources for CDD/CDF releases. The scrap metal feed for secondary nonferrous metal smelting often contains impurities such as plastics, paints, and solvents. Also, the secondary smelting of aluminum and copper includes the use of chlorine salts. Subsequently, the combustion of feed impurities and/or chlorine salts may result in CDD/CDF formation. It is estimated that the vast majority of CDD/CDFs releases from nonferrous metal smelters are emitted to air, but emissions to water and land may occur as well (U.S. EPA, 1998). Nonferrous sources that may be located at facilities subject to TRI reporting include secondary copper, aluminum, and lead smelting.

B.4.3 CHEMICAL MANUFACTURING AND INDUSTRIAL PROCESSES

Dioxins and furans can be formed as unintended byproducts from manufacturing processes. For example, CDD/CDFs are generated in pulp and paper mills during chlorine bleaching; CDD/CDFs have been detected in the effluent, sludge, and pulp of pulp and paper mills (U.S. EPA, 1998).

CDD/CDFs may also be unintentionally formed in the manufacture of chlorinated compounds such as chlorophenols, chlorobenzenes, ethylene dichloride (EDC) and vinyl chloride monomer (VCM), aliphatic chlorinated compounds, and certain dyes and pigments (U.S. EPA, 1998). Chlorophenols have been used in a variety of wood preservatives and as chemical intermediates in the manufacturing of pesticides. Chlorobenzenes are associated with the production of phenol, aniline, and various pesticides that are based on the higher chlorinated benzenes. EDC and VCM are used in the production of polyvinyl chloride (PVC). Aliphatic compounds are used in the production of plastics as solvents, cleaning agents, and as precursors for chemical synthesis (U.S. EPA, 1998).

Potential sources of CDD/CDFs from other industrial processes include non-incinerated municipal sewage sludge, industrial effluents processed by publicly owned treatment works (POTWs) and chlorine bleaching (U.S. EPA, 1998). Among these source categories, pulp and paper mills are subject to TRI reporting.

B.4.4 RESERVOIR SOURCES

CDD/CDF compounds are considered persistent and do not break down in water. They accumulate in soils, sediments, and organic matter, and therefore persist in waste disposal sites. These contaminated areas serve as reservoirs for dioxins and furans. Another reservoir source is wood preserved with pentachlorophenol. Even though CDD/CDFs are in the product (e.g., utility poles), the CDD/CDFs may eventually be released to the environment at the end of the product's life. It should be noted that CDD/CDFs are *not created* by reservoir sources. The CDD/CDFs already exist; reservoir sources retain them until potentially redistributing them at a future time. Possible methods of redistribution include: settling of dust, air suspension, erosion or dredging of contaminated sediment, decomposition of contaminated material, or combustion of contaminated material.

B.4.5 SOURCE CATEGORIES WITH ORDER OF MAGNITUDE ESTIMATES

Emissions data for five source categories—asphalt mixing plants, ferrous foundries, coke production, electric arc furnaces, and iron ore sintering—are so limited that only order of magnitude estimates for emissions are reported in the 1998 Dioxin Inventory. In most cases, no U.S. test data were reported, and the estimates were based on limited data from European studies of plants that may use technologies not directly comparable to U.S. technologies (U.S. EPA, 1998). It is not clear if facilities in these sectors have sufficient information to develop reasonable throughput or release estimates. Therefore, EPA is not able to estimate the extent of reporting from these sectors. Table B-3 presents the order of magnitude estimates (all air emissions) for these five sources. It should be noted that two of these sources—backyard trash burning and landfill fires, neither of which are subject to TRI reporting—have order of magnitude estimates that are almost as large as the largest source (municipal solid waste incinerators).

Although the 1998 Dioxin Inventory included a point estimate for dioxin releases to air from industrial coal and oil combustion, emission factors suitable for use by individual industrial facilities do not currently exist. Therefore, no reports have been predicted for coal- and oil-fired industrial sources.

B.5 PRESENT TRI STATUS

Dioxins and furans are currently not reportable under EPCRA section 313, although EPA will add a category of dioxin and dioxin-like compounds (62 FR 24887). Even if they were reportable, the current TRI reporting thresholds in the thousands of pounds are far too high to capture the small quantities, in grams, of CDD/CDFs.

Facilities that are potentially subject to TRI reporting accounted for approximately 30 percent of dioxin releases in grams TEQ in 1995. The two most significant sources of CDD/CDFs *not* covered by TRI are municipal solid waste incinerators (37 percent) and medical

waste incinerators (16 percent) (see Table B-2). These sources will be subject to MACT (Maximum Achievable Control Technology) standards under the Clean Air Act, which are expected to reduce releases in coming years.

Background levels of dioxins and furans are present in the environment. The final rule focuses TRI reporting on facilities that actually add to the environmental loading of CDD/CDFs by use of the activity qualifier. The qualifier will read as follows: (Manufacturing; and the processing or otherwise use of dioxin and dioxin-like compounds if the dioxin and dioxin-like compounds are present in a chemical and if they were created during the manufacturing of that chemical) for TRI reporting of the chemical.

TABLE B-3
ORDER OF MAGNITUDE ESTIMATES OF CDD/CDF RELEASES FROM SOURCES NOT QUANTIFIED IN THE NATIONAL INVENTORY (REFERENCE YEAR 1995)

Potential Source Category	Estimated Releases to Air (g TEQ/year)
Backyard trash burning	1,000
Landfill fires	1,000
Iron ore sintering	100
Accidental vehicle fires	10
Asphalt mixing plants	10
Coke production	10
Combustion of landfill gas from flares	10
Electric arc furnaces	10
Ferrous metal foundries	10
Residential/commercial coal combustion	10
Residential/commercial oil combustion	10
Industrial coal combustion	10
Industrial oil combustion	10
Biogas combustion	0.1

Source: U.S. EPA, 1998. Energy Information Administration, 1994 used for industrial coal and oil combustion estimates.

B.6 METHODOLOGY FOR EVALUATING THE NUMBER OF FACILITIES AFFECTED BY TRI REPORTING FOR DIOXINS AND FURANS

The following methodology was used to determine the number of facilities that may potentially report the manufacture of dioxin and dioxin-like compounds under EPCRA 313.

B.6.1 DETERMINING FACILITY-LEVEL CDD/CDF RELEASES WITHIN A SOURCE CATEGORY

EPCRA section 313 requires threshold determinations for chemical categories to be based on the total mass of all the chemicals in that category. EPA is requiring reporting on 17 congeners of dioxin and dioxin-like compounds as a single category. A facility that manufactures three of the 17 congeners, for example, would sum the congeners for the purpose of threshold determination. The source category emission factors (EFs) used to calculate emissions in the 1998 report were reported in nanograms (billionths of a gram) of CDD/CDF released per kilogram of production or consumption. The EFs are based on the aggregation of all 17 congeners. These EFs were constructed for entire industries; considerable uncertainty is introduced by applying the emission factors to facility-level throughputs because the samples are based on limited data, the samples represent only a few facilities, and because there are different technologies used in different facilities in the same industry. The total grams of CDD/CDF emissions were calculated by multiplying the EF by the throughput for each source category.

Because facility-level production and/or emissions data were not available for most source categories, an average quantity of dioxins released per facility within each category was calculated. To obtain this average, the total CDD/CDF emissions for each source category were divided by the total number of facilities in that category. Total emissions were calculated by multiplying the total throughput of the source category by the corresponding EF. Again, it should be noted that emissions do not necessarily equal the amount of CDD/CDFs manufactured.

For most source categories, the total throughput was obtained from EPA's 1998 *Inventory of Sources of Dioxin in the U.S.* Throughput refers to the annual amount of output, such as kilograms of clinker from a cement kiln, or material consumed, such as kilograms of aluminum consumed by a secondary smelter. To include only the throughput of facilities with ten or more employees (a criterion for TRI reporting), several assumptions were made. For certain source categories in which valued added data were available, it was assumed that production and consumption were proportional to value added by manufacture (one measure of production). When value added data were not available, the total throughput was multiplied by the percentage of facilities with ten or more employees. This assumes that consumption and production are proportional to the number of facilities.

To obtain the number of facilities in each category with ten or more full-time employees, the facility number from the 1998 report was multiplied by the percent of establishments with ten or more employees in the corresponding SIC code (U.S. EPA, 1998; Bureau of the Census, 1992, 1995).

In some cases, information was available that provided more refined estimates of a source category's facility-level CDD/CDF emissions. These are included in the following sector-specific descriptions. For each of these sources, the total estimated amount of dioxin for the industry sector, and the estimated dioxin per facility is shown in Table B-4.

Pulp and paper mills (SIC Code 26)

In pulp mills, dioxins may be coincidentally manufactured as a byproduct from combustion of Kraft black liquor or from the pulp bleaching process. In paper mills, dioxins may be formed from the pulp bleaching process. For pulp and paper mills, dioxin emissions were assumed to be proportional to value added by manufacture.

Stone, clay, and glass products (SIC Code 32)

Dioxins may be coincidentally manufactured as an impurity when heating raw materials to produce clinker in SIC 3241 (cement, hydraulic). Cement kilns that burned hazardous waste had a much higher emission factor than those that burned only nonhazardous waste.

Primary metal industries (SIC 33)

Dioxins may be coincidentally manufactured as a byproduct during the smelting of scrap aluminum, copper, or lead. Separate emission factors and data were available for six different furnace technologies used in secondary lead smelting.

Industrial Wood-fired combustion sources (SIC 20 - 39)

Wood-fired industrial boiler sources are used primarily in lumber, furniture, and paper related industries. The estimated number of facilities using wood was taken from the Industrial Combustion Coordinated Rulemaking (ICCR) database, Version 3 (see Appendix A for a more detailed description). The percentages of facilities that consumed the required amount of wood for each dioxin emission threshold (greater than 0 g, 0.1 g, 1 g, and 10 g) were determined from the distribution of facilities using wood as reported in the ICCR database. This percentage was then multiplied by the number of facilities, yielding an estimate for the number of facilities that would exceed the reporting thresholds due to wood combustion. It is possible that facilities using wood-fired boilers may also generate CDD/CDFs from more than one source. For example, 323 pulp and paper mills (Bureau of the Census, 1992) have effluent and land releases of dioxin. In addition, 117 wood-fired boilers in pulp and paper mills release dioxins. However, adding these facility numbers would double-count the number of facilities in SIC 2611 and 2621 that release dioxins. The total number of facilities, therefore, was adjusted to avoid double-counting facilities in SIC 2611 and 2621.

Chemicals containing dioxin as an impurity (SIC Code 20 - 39)

CDD/CDFs may be unintentionally formed in the manufacture of chlorinated compounds (EPA, 1998). Estimates were made of the number of additional reports expected from facilities

manufacturing, processing or otherwise using the following chemicals that contain dioxin as an impurity or contaminant:

Chemical Name	CAS #	Uses
Chloranil	118-75-2	dyes, pigments, pesticides
Pentachlorophenol (PCP)	87-86-5	wood preserving, pesticides
Ethylene dichloride (EDC)	107-06-2	VC/PVC production, gasoline, paints and varnishes, metal degreasing, scouring compounds, organic synthesis, solvent, fumigant
Vinyl chloride (VC)	75-01-4	PVC manufacturing, adhesives
Polyvinylchloride (PVC)	9002-86-2	plastic products
2,4-D	94-75-7	pesticides
2,4-D Ester Herbicides	1928-43-4	pesticides

The number of additional TRI reports for dioxin at lower reporting thresholds (>0, >0.1, >1, or >10 g/yr) was estimated using the following procedure:

- Determine the number of facilities manufacturing each of the chemicals listed above;
- Estimate the total volume manufactured or imported for each chemical and divide by the number of facilities manufacturing that chemical to determine the production volume per facility;
- Using data on the concentration of dioxin in each chemical, determine the dioxin manufactured at each facility for each of the chemicals; and
- Evaluate the number of facilities expected to submit additional TRI reports for each threshold.

According to the Chemical Update System (EPA, 1994b) at least 44,493 kg of chloranil are imported annually. Up to 10 facilities import chloranil (EPA, 1999) and no facilities manufacture it in the U.S. No mass-based concentration information on dioxin in chloranil was available, however, the TEQ concentration is less than 20 ug TEQ/kg (EPA, 1998) for low dioxin chloranil. Assuming that the chloranil imported is Low Dioxin Chloranil (LDC) and the mass to TEQ ratio is the same for Low Dioxin Chloranil as for High Dioxin Chloranil (EPA, 1998), a mass concentration of 12 mg/kg was calculated. Using this concentration results in an average of 53.4g of dioxin per facility importing chloranil. Thus, all ten facilities would be expected to report at any of the lower thresholds. The number of facilities processing or otherwise using chloranil was not available, therefore, additional dioxin reports expected from these facilities was not estimated.

In 1994, 8,400 metric tons of pentachlorophenol (PCP) were used in the U.S. for wood preservation (EPA, 1998). Data from 1983 show there were two facilities manufacturing PCP (Mansville, 1983). The dioxin generated per manufacturing facility was estimated using a tolerance level from a 1987 EPA Settlement Agreement for manufacturing-use PCP of an average 2 ppm of HxCDD over a month or a batch level of 4 ppm (EPA, 1998). Using these values, both manufacturing facilities are expected to submit reports for dioxin at any of the lower thresholds.

From 1995 TRI data, an estimated 36 facilities process or otherwise use PCP (EPA, 1997c). Using the 2 ppm concentration, all 36 facilities are expected to report for dioxin at any of the lower thresholds.

Approximately 31 to 36 million pounds of 2,4-D were produced in 1995 (EPA, 1997d). Assuming that this production volume also includes 2,4-D EH estimates of 2,4-D and 2,4-D EH were based on 33.5 million pounds/year, the midpoint of the production estimate. Using 1995 TRI data, five facilities are assumed to manufacture 2,4-D and/or 2,4-D EH (EPA, 1997c). Using a dioxin concentration in 2,4-D of 5.6 ppb (EPA, 1998), it was estimated that all five facilities would report for dioxin at any of the lower thresholds. For 1995, 23 facilities reported processing or otherwise using 2,4-D and/or 2,4-D EH in TRI (EPA, 1997c). Assuming these facilities process all of the 33.5 million lbs/year produced, the quantity processed or otherwise used at each facility was estimated using the "Maximum Quantity On-site" as reported on their 1995 TRI submission for 2,4-D or 2,4-D EH as an indicator of the quantity used. Using this approach, it was estimated that all 23 facilities would submit a report at the lowest level, and 3 facilities would report at the >10g/year level.

The number of reports for sites manufacturing EDC, VC, and PVC was estimated using a different approach. These estimates are based on estimated dioxin releases from 31 vinyl industry facilities, as documented by the Vinyl Institute (Vinyl Institute, 1999). The industry estimates are presented as pounds TEQ per year. This estimate was converted to grams per year assuming the mass:TEQ ratio for these sites and releases is 50:1 (Vinyl Institute, 1999). The distribution of the 31 facilities was applied to the 38 vinyl manufacturing facilities listed in an industry dioxin characterization program (Vinyl Institute, 1998). Using these data, it was estimated that all 38 facilities would report at the lowest threshold, and 6 facilities would report at the 10g threshold. From 1995 TRI data, it is estimated that 54 facilities process or otherwise use EDC. Using an EDC production value of 11,115,000 metric tons/year (Vinyl Institute, 1998), each facility's "Maximum Quantity On-site" reported in TRI (EPA, 1997c), and a concentration of 0.21pg/g (Vinyl Institute, 1998), the number of facilities reporting at each threshold was estimated: 49 facilities would report at the lowest threshold and 1 facility would report at the >10g/year threshold. Sufficient data was not available to estimate the number of facilities that would be expected to report for processing or otherwise using VC or PVC.

Electric, gas, and sanitary services (SIC Code 49)

Dioxins may be coincidentally manufactured as a byproduct during combustion of the coal or oil used by electric service facilities. The estimated number of facilities in SIC Code 4911 exceeding each threshold for dioxins was determined by calculating the total grams of dioxin manufactured at each facility using facility-specific fuel throughput information and fuel-specific emission factors. Although facilities were grouped by primary fuel type, most facilities utilize more than one fuel type. This approach accounts for dioxins manufactured due to the combustion of all fuel types at each facility.

To estimate the number of facilities in SIC codes 4931 and 4939, the percentage of facilities in SIC code 4911 exceeding each threshold was applied to the number of facilities in SIC codes 4931 and 4939 by fuel type.

B.6.2 NON-DETECTED LEVELS OF DIOXINS AND FURANS FROM ACTUAL TESTING

Emissions testing for dioxins and furans was conducted at various facilities to determine emission factors and to provide congener-specific profiles. The 1998 Dioxin Inventory provides emission factors for two different scenarios: non-detected values or "non-detects" (ND) were assumed to equal zero, and ND were assumed to equal one-half the detection limit. Setting ND to zero means that for test samples where no dioxin was detected, it was assumed that no dioxins were actually present. Setting ND to one-half the detection limit means that for test samples where no dioxin was detected, it was assumed that one-half the detection limit was present (i.e., for a detection limit of one part per million (ppm), it would be assumed that 0.5 ppm of dioxin was present). The only three source categories whose emission estimates were significantly affected by this choice are kraft recovery boilers and coal- and oil-fired sources; when ND equaled one-half the detection limit, emissions were 32 percent, 34 percent, and 24 percent higher, respectively, than emissions when ND equaled zero. For this profile, it was assumed that ND equals one-half the detection limit (Abt Associates, 1998). This is an analytical assumption for the purpose of estimating the number of facilities that may report to TRI. Individual facilities should refer to the TRI reporting instructions and Agency guidance for purposes of reporting. Emission factors associated with ND values equal to one-half the detection limit were used to estimate dioxin emissions from SIC codes for which facility-level data were not available. Table B-4 presents total and per facility dioxin emission estimates for these SIC codes.

TABLE B-4
DIOXINS AND FURANS SUMMARY TABLE (ND = ½ DL)

SIC Code	Industry	Dioxin Purpose/Use	Total Amount of Dioxin (g/yr)		Dioxins/ Facility (g/yr)
2611	Pulp mills	Formed from combustion of Kraft black liquor	144	154	3.4
		Formed from the pulp bleaching process	10		
2621	Paper mills	Formed from the pulp bleaching process		58	0.2
3241	Cement, hydraulic	Formed when heating raw materials to produce clinker		732	5.2
3341	Secondary nonferrous metals	Formed during the smelting of scrap aluminum	97	490	7.8
		Formed during the smelting of scrap copper	387		
		Formed during the smelting of scrap lead	6		
20-39	Manufacturing	Formed during the combustion of wood		242	0.3
4953	Commercial Hazardous Waste Treatment	Formed during the incineration of hazardous waste (boilers/industrial furnaces)	3	38	0.4
		Formed during the incineration of hazardous waste (incinerators)	35		

B.7 SUMMARY OF RESULTS — EXPECTED REPORTING

After estimating the facility-level emissions in each source category, the number of facilities expected to report for a given threshold was estimated. Again, it should be noted that the reporting threshold is based on the manufacture of the compounds, which is not necessarily the same as the emission or release. For dioxins and furans, four different thresholds were analyzed: greater than 0 grams, greater than 0.1 grams, greater than 1 gram, and greater than 10 grams. A summary of the results is shown in Table B-5.

TABLE B-5
ESTIMATES OF ADDITIONAL TRI REPORTING FOR DIOXIN AND DIOXIN-LIKE COMPOUNDS

SIC Code	Industry Sector	Total Number of Facilities with 10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				Greater than 0 grams	Greater than 0.1 grams	Greater than 1 gram	Greater than 10 grams
2611	Pulp mills	45	N/A	45	45	32	0
2621	Paper mills	278	N/A	278	150	0	0
3241	Cement kilns	142	N/A	142	142	142	23
3341	Secondary aluminum smelters	46	N/A	46	46	46	0
3341	Secondary copper smelters	2	N/A	2	2	2	2
3341	Secondary lead smelters	15	N/A	15	9	0	0
28	Manufacturing chemicals containing dioxin as an impurity	55	N/A	55	54	34	23
20-39	Processing/otherwise using chemicals containing dioxin as an impurity	113	N/A	108	57	46	40
20-39	Wood-fired industrial sources	966	N/A	966	221	34	2
4911	Coal-fired utilities Oil-fired utilities	390 124	N/A	390 124	378 54	291 20	47 0
4931	Coal-fired utilities Oil-fired utilities	197 98	N/A	197 98	191 43	147 16	24 0
4939	Coal-fired utilities Oil-fired utilities	19 14	N/A	19 14	18 6	14 2	2 0
4953	Commercial Hazardous Waste Treatment (industrial boilers and furnaces, hazardous waste)	49	N/A	49	0	0	0
4953	Commercial Hazardous Waste Treatment (hazardous waste incinerators)	59	N/A	59	59	0	0
	TOTAL FOR ALL FACILITIES [a]	**2612**	N/A	**2607**	**1475**	**826**	**163**

[a]The total numbers of facilities were adjusted to avoid double-counting facilities in SIC (Standard Industrial Classification) 2611 and 2621 that are also wood-fired industrial sources.

LITERATURE CITED

1. Federal Register (1988). Toxic Chemical Release Forms, 40 CFR Part 372. 53 FR 4500, February 16.

2. Mansville Chemical Products (1983). Chemical Products Synopsis, Pentachlorophenol. Cortland, NY.

3. U.S. Department of Commerce (1992). Census of Manufactures: Final Reports, Industry Series.

4. U.S. Department of Commerce (1992). County Business Patterns, United States.

5. U.S. Department of Commerce (1995). County Business Patterns, United States.

6. U.S. Department of Energy (1994). Manufacturing Energy Consumption Survey.

7. U.S. Department of Health and Human Services (1997). Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. Draft for Public Comment (Update).

8. U.S. EPA (1994a). Estimating Exposure to Dioxin-Like Compounds. Volume I: Executive Summary. External Review Draft (1994). Office of Health and Environmental Assessment. EPA 600-6-88-005Ca.

9. U.S. EPA (1994b). Chemical Update System report for chloranil. Information Management Division. Search completed July 23, 1999.

10. U.S. EPA (1995). Profile of the Pulp and Paper Industry. Office of Compliance, Office of Enforcement and Compliance Assurance. EPA 310-R-95-015.

11. U.S. EPA (1997a). Locating and Estimating Air Emissions from Sources of Dioxins and Furans. Office of Air Quality Planning and Standards, Office of Air and Radiation. EPA 454-R-97-003.

12. U.S. EPA (1997b). Economic Analysis of the Final Rule to Add Certain Industries to EPCRA Section 313. Office of Pollution Prevention and Toxics.

13. U.S. EPA (1997c). 1995 Toxics Release Inventory (TRI) Database.

14. U.S. EPA (1997d). Pesticides Industry Sales and Usage, 1994 and 1995 Market Estimates. Office of Prevention, Pesticides and Toxic Substances. EPA733-R-97-002.

15. U.S. EPA (1998). The Inventory of Sources of Dioxin in the United States. Review Draft. Office of Research and Development. EPA 600-P-98-002Aa.

16. U.S. EPA (1998b). Industrial Combustion Coordinated Rulemaking (ICCR) Database, Version 3, Office of Pollution Prevention and Toxics.

17. U.S. EPA (1999). 1999 Toxics Release Inventory (TRI) Database.

18. Vinyl Institute (1998). The Vinyl Institute Dioxin Characterization Program, Phase I Report. Prepared by the Vinyl Institute, Morristown, NJ.

19. Vinyl Institute (1999). Comments of the Vinyl Institute on Persistent Bioaccumulative Toxic (PBT) Chemicals Proposed Rule. Submitted to EPA April 7. Comment #C-1853.

PERSONAL COMMUNICATIONS

1. Abt Associates (1998). Memorandum from Dennis Chang and Susan Day to Cody Rice (EPA/OPPT). Background Source Category Tables for the Dioxin Profile for the TRI PBT Rule (November 12).

2. Eastern Research Group (ERG) (1998). Memorandum from Mae Thomas and Jeanette Ray to Cody Rice (EPA/OPPT). Boiler Data Summaries for TRI Analysis (May 18).

3. U.S. EPA (1999). Teleconference between Cody Rice (EPA/OPPT) and Mary Begley (EPA/CCD) on the number of chloranil importers. July 7.

4. U.S. EPA (1999b) Meeting Between Cody Rice (EPA/OPPT) and David Cleverly (EPA/ORD) on application of emission factor to secondary copper smelters. July 14.

APPENDIX C
HEXACHLOROBENZENE

C.1 CHEMICAL PROFILE

Hexachlorobenzene (CAS 118-74-1) is an organo-chlorine compound. It is a white crystalline solid created by the chlorination of a benzene ring.

C.1.1 PRODUCTION

Most hexachlorobenzene is produced as a byproduct in chemical manufacturing processes. It is also produced as an impurity in the manufacture of pentachlorophenol, pesticides, chlorinated organic chemicals, chlorine gas, and certain metal smelting and refining operations. Hexachlorobenzene can also be formed during the combustion of chlorinated organic compounds and coal.

Production in the Pesticides industry

Hexachlorobenzene was once used as an agricultural fungicide, but health concerns about the toxicity of hexachlorobenzene led to the cancellation of the registrations of all pesticides that contained hexachlorobenzene as an active ingredient. Its primary use was to treat wheat seeds, onions, and sorghum. As late as 1985 it was used to prevent wheat smut. Although no longer used as an active ingredient in pesticides, hexachlorobenzene is contained as an impurity or formed as a byproduct during the manufacturing of the pesticides ametryn, atrazine, cyanazine, dacthal, dienochlor, dipropetryn, lindane, maleic hydrazide, mirex, pentachloronitrobenzene, picloram, prometon, prometryn, propazine, simazine, and terbutryn.

Most manufacturers of pesticides containing hexachlorobenzene as an active ingredient canceled their registrations in 1984, with the final manufacturer canceling all registrations for pesticide products containing hexachlorobenzene as an active ingredient in 1985 (EPA, 1986). Under the cancellation, existing inventories of pesticides containing hexachlorobenzene as an active ingredient were allowed to be used until July 1985.

In 1982, the pesticide industry produced an estimated 1.52 million pounds of hexachlorobenzene, with 0.65 million pounds as product impurities and 0.87 million pounds as production residues (PEI Associates, 1985). In 1990, EPA estimated that 2,880 pounds of hexachlorobenzene were applied as a pesticide impurity to corn, fruits, vegetables, residential and industrial lawns, roadsides, and golf courses (EPA, 1997c).

Production of Hexachlorobenzene From Other Sources

A number of manufacturing processes for chlorinated organic compounds generate hexachlorobenzene as a byproduct or impurity. During the manufacture of chlorinated organic chemicals, hexachlorobenzene may be formed by thermal chlorination, oxychlorination, and pyrolysis when carbon and chlorine react at high temperatures. Hexachlorobenzene is usually found in the still bottoms generated during product purification or distillation and is an air emissions from distillation columns (EPA, 1993). Hexachlorobenzene may also be found as an impurity in the commercial chlorinated solvent products (PEI, 1985). Chlorinated solvent use has fallen 50 to 70 percent since the early 1980s and therefore the related byproduct manufacture of hexachlorobenzene wastes has fallen significantly.

Hexachlorobenzene is produced during the manufacture of chlorine gas from aqueous sodium chloride or potassium chloride by an electrolytic process. The electrolytic process, involving an anode made of powdered graphite with a coal tar pitch binder, leads to the production of a mixture of chlorinated organics that are later removed as a waste byproduct. This waste byproduct, known as "taffy", may contain hexachlorobenzene (EPA, 1997d). Powdered graphite anodes with coal tar pitch binders were used exclusively for chlorine production until 1979; however, the development of noble metal oxide coatings on titanium substrates has led to a drastic reduction in the use of graphite electrodes. Most chlorine producers presently use ruthenium oxide or titanium oxide coated anodes rather than graphite anodes (Kroschwitz, 1994); it is estimated that five chlorine gas manufacturers continue to use graphite anodes in their production processes (EPA, 1986). Hexachlorobenzene production from operations not employing graphite anodes is considered unlikely due to the lack of a carbon source in these processes.

Hexachlorobenzene is also a potential byproduct formed during the production of metallic magnesium when produced via electrolysis with carbon electrodes (Kroschwitz, 1994). The process leads to the formation of considerable amounts of chlorinated hydrocarbons, including hexachlorobenzene. According to the International Magnesium Association, there are two metallic magnesium plants operating in the United States that use carbon electrodes. The combined capacity of these two facilities is 100,000 metric tons of metallic magnesium per year (IMA, 1998).

The degassing of molten aluminum with hexachloroethylene at aluminum foundries and secondary aluminum smelting plants also produces hexachlorobenzene (Westberg et al., 1997). Hydrogen gas from surrounding water vapor dissolves readily in molten aluminum, causing mechanical problems in the aluminum when it is cast. Degassing operations remove the hydrogen gas from the molten aluminum. Gaseous emissions from hexachloroethylene-based aluminum degassing contain high yields of complex organo-chlorine compounds, including hexachlorobenzene. (Westberg, et al., 1997).

C.1.2 RELEASES

The Clean Air Act Section 112(c)(6) 1990 inventory reports the following air emissions sources for hexachlorobenzene: manufacture of chlorinated solvents, 49% (21 facilities); pesticides manufacturing, 39% (10 facilities); and pesticide application, 12% (number of pesticide application facilities not available). Air emissions of hexachlorobenzene from pesticides applications and chlorinated solvent manufacture in 1990 were estimated at 404,000 pounds and 1,100 pounds, respectively (EPA, 1993). Possible air releases from waste incinerators and other combustion sources appeared to be minor. These estimates do not account for releases to other media or waste management activities. Hexachlorobenzene is expected to be released from the combustion of coal at a rate of 8.42×10^{-10} tons of hexachlorobenzene per ton of coal combusted (EPA, 1997d). More discussion regarding hexachlorobenzene emissions from coal combustion is provided in Appendix A.

C.2 CURRENT TOXICS RELEASE INVENTORY (TRI) STATUS

Hexachlorobenzene is currently listed on the Toxics Release Inventory (TRI). Table C-1 summarizes the number of hexachlorobenzene TRI reports by four industries in 1996. A total of 24,301 pounds of Section 8.1 hexachlorobenzene releases was reported to TRI in 1996. A total of 2,448,798 pounds of hexachlorobenzene was reported under Section 8 (8.1-8.8), which includes releases, energy recovery, recycling, treatment, and one-time releases. (EPA, 1998)

TABLE C-1
SUMMARY OF TRI REPORTING FOR HEXACHLOROBENZENE, 1996

SIC Code	Number of Form Rs	Number of Form As
Alkalies and Chlorine (SIC Code: 2812)	5	0
Cyclic Organics (SIC Code: 2865)	1	0
Other Industrial Chemicals (SIC Code: 2869)	1	0
Pesticides (SIC Code: 2879)	3	0
TOTAL	**10**	**0**

Source: (EPA, 1998)

C.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS

This section presents estimates of additional TRI reporting for hexachlorobenzene, assuming that reporting thresholds are lowered. Four reporting threshold levels were analyzed: 1 pound; 10 pounds; 100 pounds; and 1,000 pounds. The following estimates also assume that the *de minimis* exemption would be eliminated; thus TRI reporting is expected from facilities manufacturing, processing, or otherwise using hexachlorobenzene at the lower thresholds, regardless of the concentration.

C.3.1 ANALYTICAL METHODS

This section describes the process used to estimate the number of additional reports at lower thresholds. The initial analysis began by identifying industries using certain chemicals in which hexachlorobenzene is known or expected to be an impurity (EPA, 1997a, EPA, 1990, EPA, 1986). Table C-2 lists the chemicals that are known or suspected to contain hexachlorobenzene and their estimated hexachlorobenzene fractions. The fractions of hexachlorobenzene vary for pesticides and other organic chemicals, but are expected to be low, so a general designation of <1% is used. Where hexachlorobenzene fractions in a particular chemical are unknown, the average hexachlorobenzene fraction for all chemicals (0.0002), with the exception of hexachlorobenzene, is used. The calculation of the average hexachlorobenzene fraction is presented below:

[DCPA (0.001) + chlorothalonil (0.00005) + picloram (0.00005) + atrazine (0.000001) + simazine (0.000001) + lindane (0.0001) + PCNB (0.0005)+ pentachlorophenol (0.00015)]/8
= 0.0002

Using the available information (EPA, 1993) and the data in Table C-2, the manufacturing facilities in SIC Codes 20 through 39 that potentially manufacture, process or otherwise use hexachlorobenzene were identified. To summarize the data into a useable format, the facilities in SIC Codes 20 through 39 were categorized into three groups; 1) use of hexachlorobenzene in processing operations; 2) manufacture of chemicals in which hexachlorobenzene is a byproduct or impurity; and 3) process or otherwise use of chemicals in which hexachlorobenzene is a byproduct or impurity. In each group, the total facility usage of each reported chemical is assumed to be greater than the TRI reporting threshold or the amount of chemical released, as reported to TRI, whichever is larger. For those industries where specific operations either manufacture, process or otherwise use hexachlorobenzene, a detailed analysis by SIC code is provided in the subsequent sections.

TABLE C-2
CHEMICALS SUSPECTED TO CONTAIN HEXACHLOROBENZENE

Chemical Name	CAS No.	Fraction Hexachlorobenzene
Allyl chloride	107-05-1	0.0002[b]
Ametryn	834-12-8	0.0002[b]
Atrazine	118-74-1	0.000001[c]
Benzyl chloride	100-44-7	0.0002[b]
Carbon tetrachloride	56-23-5	0.0002[b]
Chlorine	7782-50-5	0.0002[b]
Chlorobenzene	108-90-7	0.0002[b]
1-Chloropropane	540-54-5	0.0002[b]
Chlorothalonil	1897-45-6	0.00005[c]
Cyanazine	21725-46-2	0.0002[b]
Cyanuric chloride	108-77-0	0.0002[b]
DCPA (dacthal)	1861-32-1	0.001[c]
1,2-Dichlorobenzene	95-50-1	0.0002[b]
1,2-Dichloroethylene	79-01-6	0.0002[b]
2,4-Dichlorophenol	120-83-2	0.0002[b]
Dienochlor	2227-17-0	0.0002[b]
1,3-Dichlorobenzene	541-73-1	0.0002[b]
1,4-Dichlorobenzene	106-46-7	0.0002[b]
1,2-Dichloroethane	107-06-2	0.0002[b]
1,3-Dichloropropene	542-75-6	0.0002[b]
Dipropetryn	4147-51-7	0.0002[b]
Ethyl chloride	75-00-3	0.0002[b]
Freon 113	76-13-1	0.0002[b]
Hexachlorobenzene	118-74-1	~1.0[a]
Hexachlorocyclopentadiene	77-47-4	0.0002[b]
Hexafluorobenzene	392-56-3	0.0002[b]
Lindane	58-89-9	0.0001[c]
Maleic hydrazide	123-33-1	0.0002[b]
Mirex	2385-85-5	0.0002[b]
Pentachlorobenzene	608-93-5	0.0002[b]
Pentachloronitrobenzene	82-68-8	0.0005[c]

TABLE C-2
CHEMICALS SUSPECTED TO CONTAIN HEXACHLOROBENZENE

Chemical Name	CAS No.	Fraction Hexachlorobenzene
Pentachlorophenol	87-86-5	0.00015[d]
Phosgene	75-44-5	0.0002[b]
Phthalic Anhydride	85-44-9	0.0002[b]
Picloram	1918-02-1	0.00005[c]
Polyvinyl chloride	75-34-1	0.0002[b]
Prometon	1610-18-0	0.0002[b]
Prometryn	7287-19-6	0.0002[b]
Propazine	139-40-2	0.0002[b]
Simazine	122-34-9	0.000001[c]
Terbutryn	886-50-0	0.0002[b]
Tetrachloroethylene	127-18-4	0.0002[b]
Tetrachlorophthalic anhydride	117-08-8	0.0002[b]
Toluene diisocyanate	584-84-9	0.0002[b]
Trichloroethylene	79-01-6	0.0002[b]
1,1,1-Trichloroethylene	71-55-6	0.0002[b]
1,2,4-Trichlorobenzene	120-82-1	0.0002[b]

[a] Fraction of impurities in hexachlorobenzene is unknown, therefore the hexachlorobenzene fraction is assumed to be 1.0.
[b] Fraction is average of known fractions.
[c] Source: (EPA, 1997d)
[d] Source: (EPA, 1986)
Additional Sources for identifying chemicals known or suspected to contain hexachlorobenzene: (Spectrum Laboratories, undated), (EPA 1997c), (British Horological, undated), (PEI, 1985), (ATSDR, 1990), (NJDH, 1988), (EPA, 1986),(EPA, 1993)

Alkalies and Chlorine (SIC Code 2812, manufacturing of chlorine gas only)

The number of facilities that may submit TRI reports for hexachlorobenzene at various thresholds for SIC code 2812 (alkalis and chlorine) were estimated from the *Final Draft Report - Exposure Assessment for Hexachlorobenzene* (EPA, 1986). According to the report, only five chlorine manufacturing facilities in the United States had not converted from graphite (carbon) electrodes to metal electrodes by 1984. The 1995 TRI (EPA, 1997b) information shows that 4 chlorine manufacturing facilities had reported hexachlorobenzene manufacturing. These data indicate that at least four, and possibly five chlorine manufacturing facilities are still using carbon electrodes and may submit TRI reports for hexachlorobenzene. However, since four of these facilities submitted reports to TRI in 1995 for the manufacture of hexachlorobenzene, only one additional facility is expected to report manufacturing of hexachlorobenzene to TRI under lowered thresholds. The amount of hexachlorobenzene manufactured by this industry is estimated to be greater than 100,000 lbs/year based on a minimum of the threshold reporting quantity for

the four reporting facilities. The average per facility is estimated to be greater than 25,000 lbs/year for the four currently-reporting facilities and less than 25,000 lbs/year for one facility.

Additional facilities in SIC code 2812 may produce or otherwise use hexachlorobenzene from sources other than the manufacture of chlorine gas, such as the manufacture, production, or otherwise use of chlorinated organics. These facilities are included in the categorical listings for SIC codes 20-39.

Manufacturing of Hexachlorobenzene (SIC Codes 2865, 2869, 2879)

The manufacture of chlorinated organic chemicals and pesticides may result in the generation of hexachlorobenzene as a byproduct or impurity. In addition, hexachlorobenzene may be manufactured for use as a raw material or intermediate in the manufacture of chlorinated organic chemicals or pesticides. For the 1995 reporting year, 5 facilities in SIC codes 2865, 2869, and 2879 reported the manufacture of hexachlorobenzene in quantities greater than the 25,000 pound threshold. Since the manufacture of hexachlorobenzene in these SIC codes is expected in large quantities, additional reports at lower thresholds would not be expected. Therefore, no additional reports for hexachlorobenzene manufacturing would be expected at the lower reporting thresholds.

Magnesium Production (SIC Code 3339)

Hexachlorobenzene has been identified as a potential byproduct of metallic magnesium production from magnesium chloride using carbon electrodes. According to the available information, annual hexachlorobenzene byproduct manufacture was estimated between 500 and 700 pounds from one facility located in Norway (Knutzen and Oehme, 1989). The actual concentration of hexachlorobenzene in the process wastes is unknown. There are two U.S. metallic magnesium plants (EPA, 1998); assuming that the magnesium plant in Norway is similar in size to these plants, then between 1,000 and 1,400 pounds per year of hexachlorobenzene byproduct is expected from this process in the United States. Therefore, the two U.S. metallic magnesium producers may report to TRI at thresholds of 1 pound, 10 pounds, and 100 pounds.

Additional facilities in SIC code 3339 may manufacture, produce, or otherwise use hexachlorobenzene from sources other than metallic magnesium production from magnesium chloride using carbon electrodes. These facilities are included in the categorical listings for SIC codes 20-39.

Aluminum Production (SIC Codes 3341 and 3365)

Hexachlorobenzene is manufactured as a byproduct in the aluminum production industry when hexachloroethane is used to remove hydrogen gas from molten aluminum (Westberg et al., 1997). Quantitative information on the amount of hexachlorobenzene produced in comparison to the amount of hexachloroethane used was available from the literature (Westberg et al., 1997). This information was used to estimate the amount of hexachlorobenzene generated by the

degassing process. According to the Aluminum Association, five secondary aluminum smelting operations in the United States use hexachloroethane for degassing; this information was used to estimate the number of primary aluminum foundries that may use hexachloroethane for degassing.

According to the literature, a remelt furnace was charged with 70 kg of an aluminum alloy and degassed using two 50 g tablets containing 85% hexachloroethane (Westberg et al., 1997). This results in a ratio of 0.00121 lb hexachloroethane/lb aluminum alloy, as shown below.

(2 × 50 g hexachloroethane × 85%) / 70,000 g alloy

= 0.00121 g hexachloroethane / g alloy

= 0.00121 lb hexachloroethane / lb alloy

Analysis of the emissions from the process detected 4.3 mg hexachlorobenzene per gram of hexachloroethane (Westberg et al., 1997). Using this information, a hexachlorobenzene:aluminum alloy ratio of 5.2×10^{-6} was calculated and is shown below.

(0.0043 g hexachlorobenzene / g hexachloroethane) × (0.00121 g hexachloroethane / g alloy)

= 5.2×10^{-6} lbs hexachlorobenzene/lb aluminum alloy

To estimate the number of aluminum foundries using hexachloroethane in degassing, the percentage of secondary smelting plants using hexachloroethane in degassing was applied to the number of aluminum foundries. These data are presented in Table C-3.

TABLE C-3
ESTIMATED NUMBER OF ALUMINUM FOUNDRIES
USING HEXACHLOROETHANE (HCE) DEGASSING OPERATIONS

SIC Code	Total Foundries[a]	Total Secondary Smelting Facilities[a]	Secondary Smelting Facilities Using HCE[b]	% of Total Secondary Smelting Facilities Using HCE	Estimated Foundries Using HCE
3365	591	72	5	7	41

Sources:
[a]Department of Commerce, 1992
[b]EPA, 1993

The amount of aluminum produced by secondary smelting facilities using hexachloroethane was available from the Aluminum Association; however, only the total primary aluminum production was available from the listed references. Assuming that the foundries produce approximately equal amounts of aluminum each year, a scaling factor of 7% (calculated above) was applied to estimate the amount of primary aluminum production using

hexachloroethane degassing operations. Table C-4 presents the estimated amount of hexachlorobenzene manufactured by the primary and secondary aluminum industry.

TABLE C-4
ESTIMATED ALUMINUM INDUSTRY HEXACHLOROBENZENE MANUFACTURE

SIC Code	Estimated Amount of Aluminum Manufactured (million lb/year)	HCB:Aluminum ratio	Total Estimated Amount of HCB Manufactured (lb/year)
3341	108[a]	5.2×10^{-6}	550
3365	556[b]	5.2×10^{-6}	2,900

Sources:
[a]Aluminum Association, 1998 (converted from 53,922 tons)
[b]3,600,000 metric tons aluminum (USGS, 1998) × (2,205 lb / metric ton) × 7% using hexachloroethane = 556,000,000 lb aluminum using hexachloroethane

Using the data provided above for the number of facilities using HCE and the amount of HCE manufactured, it is estimated that an average of 110 lbs/year and 70 lbs/year are manufactured per secondary aluminum smelting plant and aluminum foundry, respectively.

Additional facilities in SIC codes 3341 and 3365 may manufacture, produce, or otherwise use hexachlorobenzene from sources other than as a potential byproduct of aluminum degassing using hexachloroethane, such as the manufacture, production, or otherwise use of chlorinated organics. These facilities are included in the categorical listings for SIC codes 20 through 39.

Combustion Sources

Hexachlorobenzene is a potential byproduct of coal combustion. To estimate the number of manufacturing facilities in SIC codes 20-39 and the number of electric utilities in SIC code 49 that may reach the lower reporting thresholds due to coal combustion, an estimated emission factor, 8.42×10^{-10} tons HCB/ton coal, was determined from the total hexachlorobenzene emissions from electric coal burning utilities in 1990 (USEPA, 1997d) and the amount of coal consumption in SIC code 4911. A complete discussion regarding the impact of coal combustion on the number of additional TRI reports that may be submitted in SIC codes 20 through 39 and in SIC code 49 is provided in Appendix A.

Commercial Hazardous Waste Treatment (SIC Code 4953)

To estimate the number of commercial hazardous waste treatment facilities that may report on hexachlorobenzene at lower reporting thresholds, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose. First, TRI data may underestimate the *number of reporting facilities* because TRI- subject hazardous waste facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the hazardous waste facility may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities, and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of hazardous waste treatment facilities at which amounts of hexachlorobenzene would exceed a lower reporting threshold (1, 10, 100, 1,000 lbs) were counted. Facilities exceeding current reporting thresholds were not included in this count.

Chemicals and Allied Products - Wholesale (SIC Code 5169)

Facilities in SIC code 5169 have not yet submitted reports to EPA for TRI. Results of a telephone survey of 9 facilities indicated that none of the facilities with 10 or more employees in SIC code 5169 handled chemicals containing hexachlorobenzene. For this analysis, 1%, or 7 of the 717 facilities that are expected to report under the existing thresholds are assumed to submit a report for hexachlorobenzene. In this industry, HCB is processed as a component of chlorinated solvents.

Information is not currently available on the amount of hexachlorobenzene processed or otherwise used at facilities in SIC code 5169, therefore the amount per facility is listed as unknown, and the number of additional TRI reports is listed as 0 - 7 for all thresholds except 1 pound. The number of additional TRI reports for hexachlorobenzene at the 1-pound threshold is listed as 3 - 7 because 3 facilities in SIC code 5169 did submit TRI reports for chemicals listed in Table C-2 in 1995. Because facilities in SIC code 5169 are not currently required to conduct TRI reporting, it is believed that these 3 facilities submitted TRI reports voluntarily.

Solvent Recovery Services (SIC 7389)

Facilities in this industry have not yet reported on HCB under current TRI reporting requirements because the amount of HCB is less than current reporting threshold amounts, and because the HCB concentration in chemicals in this industry is below *de minimis* levels.

To estimate the number of solvent recovery facilities in SIC 7389 that may report to TRI for hexachlorobenzene (HCB) under the final rule, data on the prevalence of chemicals potentially contaminated with HCB at these facilities were examined. In this industry, HCB is processed as a component of chlorinated hydrocarbons for solvent recovery, or as a component of chlorinated solvents otherwise used.

As part of the data collection for the economic analysis of TRI industry expansion, several solvent recovery facilities in SIC 7389 were contacted to determine which TRI chemicals they handled in amounts exceeding 25,000 pounds. Some of the chemicals that these facilities reported handling may contain HCB in trace amounts (see Table C-5).

Of the 11 facilities for which data were available, 10 reported handling more than 25,000 pounds of at least one chemical associated with possible HCB contamination. Assuming each of the 10 facilities handled at least 50,000 pounds of contaminated chemical at 0.02 percent HCB, these facilities would be expected to report at a 1 pound or 10 pound reporting threshold based on the following calculation:

50,000 lb solvent × (0.0002 lb HCB/ lb solvent) = 10 lb HCB.

The highest number of potentially contaminated chemicals reported at any one facility was five. Assuming this facility handled 50,000 pounds of each of the solvents at 0.02 percent HCB, this facility would be expected to report at a 1 pound or 10 pound threshold, but not at a 100 pound or 1,000 pound threshold based on the following calculation:

5 solvents × 50,000 lb solvent (0.0002 lb HCB/ lb solvent) = 50 lb HCB.

To extrapolate the results from the surveyed facilities to potential reporters in SIC 7389, the percentage of facilities reporting at least one contaminated chemical (10/11 = 91%) was applied to a total of 52 active solvent recovery facilities as identified in *EI Digest*. This results in an estimate of 47 facilities expected to report at the 1 and 10 pound thresholds.

TABLE C-5
CHEMICALS REPORTED ABOVE 25,000 POUNDS IN PHONE SURVEY OF SOLVENT RECYCLERS FROM TRI INDUSTRY EXPANSION

CAS	Chemical Name	Number of Facilities
71-55-6	1,1,1-Trichloroethane	4
76-13-1	Freon 113	2
79-01-6	Trichloroethene	4
95-50-1	1,2-Dichlorobenzene	1
108-90-7	Chlorobenzene	1
127-18-4	Tetrachloroethene	9
25321-22-6	Dichlorobenzene	1

Manufacturing Chemicals In Which Hexachlorobenzene Is A Byproduct Or Impurity (SIC Codes 20 Through 39)

Hexachlorobenzene may be manufactured as a byproduct or impurity during the manufacture of chlorinated organic compounds. To estimate the total amount of hexachlorobenzene manufactured, information from the 1995 TRI database, including the number

of facilities reporting, the reporting threshold (25,000 pounds for manufacturing), and the reported current releases, was used. This information was used in conjunction with the hexachlorobenzene fractions listed in Table C-2. Total facility manufacture of each reported chemical is assumed to be greater than the reporting threshold of 25,000 pounds or the amount of chemical sent off site, whichever is larger. The amount manufactured is then multiplied by the fraction of the chemical that is believed to be hexachlorobenzene.

For example, one facility from SIC Code 2879 (pesticides), submitted a TRI report for the manufacture of ametryn in 1995. The facility also reported off-site transfers of 17 pounds of ametryn. Since the reporting threshold of 25,000 pounds is greater than the total off-site transfers, the amount of hexachlorobenzene manufactured by the facility is calculated using the estimated fraction of hexachlorobenzene in ametryn from Table C-2 as follows:

$$>25{,}000 \text{ lb ametryn} \times 0.0002 \text{ lb hexachlorobenzene/lb ametryn}$$

$$= >5 \text{ lb hexachlorobenzene}$$

This amount is then summed for all chemicals at all facilities reporting to TRI in 1995 for the manufacture of chemicals containing hexachlorobenzene as a byproduct or impurity, resulting in a total of greater than 3,600 pounds of HCB per year.

The number of facilities potentially subject to reporting requirements is 131, based on the number of facilities in the 1995 TRI database (EPA, 1997b) that reported the manufacture of chemicals in which hexachlorobenzene is a byproduct or impurity. The typical hexachlorobenzene fraction is 0.0002, which yields 5 pounds when multiplied by the reporting threshold for manufacturing of 25,000 pounds. Therefore, all facilities that submitted TRI reports in 1995 for the manufacture of chemicals that contain hexachlorobenzene as a byproduct or impurity are assumed to be subject to reporting requirements for a hexachlorobenzene threshold of one pound. To avoid double counting, facilities included in SIC codes discussed previously are not included.

Although the fraction of hexachlorobenzene in some chemicals multiplied by the minimum reportable quantity results in estimates slightly less than 1 pound, it is assumed that the total quantity of hexachlorobenzene at these facilities would also be 1 pound. The amount of hexachlorobenzene is then summed for all chemicals at each facility. This sum is then used to determine whether a facility would submit TRI reporting for hexachlorobenzene under each lowered threshold.

Processing or Otherwise Using Chemicals In Which Hexachlorobenzene Is A Byproduct Or Impurity (SIC Codes 20 Through 39)

Hexachlorobenzene may be processed or otherwise used as a byproduct or impurity during the processing or otherwise use of chlorinated organics or pesticides (PEI, 1985). The number of facilities in the processing or otherwise using category have been calculated in the same manner as those in the “Manufacturing Chemicals In Which Hexachlorobenzene Is A Byproduct Or Impurity (SIC Codes 20 Through 39)”, except the appropriate thresholds are used for

manufacturing (25,000 pounds) and otherwise use (10,000 pounds). Using this methodology, an estimated total of greater than 26,000 pounds per year of hexachlorobenzene is processed or otherwise used annually by 3,122 facilities. To avoid double counting, facilities included in SIC codes discussed previously are not included.

Summary

Facilities manufacturing, processing, or otherwise using hexachlorobenzene that may be required to submit TRI reports at the lower thresholds are presented in Table C-6. An estimate of the number of facilities currently reporting to TRI is also provided. Included are industries reporting hexachlorobenzene in the 1995 TRI database and selected industries not currently subject to TRI reporting, including SIC codes 4953, 5169, and 7389.

TABLE C-6
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR HEXACHLOROBENZENE (HCB)

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
20-39	Combustion sources only	13	0	13	0	0	0
2812	Alkalies and Chlorine (manufacturing of chlorine gas only)	5 (U.S. EPA, 1997b)	4	1	1	1	1
3339	Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminum	2 (U.S. EPA, 1998)	0	2	2	2	0
3341	Secondary Smelting and Refining of Nonferrous Metals	5 (Aluminum Association, 1998)	0	2	2	2	0
3365	Aluminum Foundries	41 (U.S. Census, 1992)	0	40	41	41	0
33	**Primary Metals TOTAL**	48	0	44[a]	45	45	0
4911, 4931, and 4939	Utility Coal Combustion (combustion sources only)	606 (U.S. EPA, 1997b)	Coal: 0 Coal: 0 Coal: 0	Coal: 263 Coal: 133 Coal: 13	Coal: 22 Coal: 11 Coal: 1	Coal: 0 Coal: 0 Coal: 0	Coal: 0 Coal: 0 Coal: 0
4953	Commercial Hazardous Waste Treatment	162 (U.S. EPA, 1997c)	0	2	2	2	2
5169	Chemicals and Allied Products-Wholesale	7	0	3 - 7	0 - 7	0 - 7	0 - 7

TABLE C-6
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR HEXACHLOROBENZENE (HCB)

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
7389	Solvent Recovery Services	191	0	47	47	0	0
2865, 2869, 2879	Manufacturing of HCB	5 (U.S. EPA, 1997b)	5	0	0	0	0
20-39	Manufacturing of chemicals in which HCB is a byproduct or impurity	131	0	131	76 - 131	3 - 131	0 - 131
20-39	Use of chemicals in which HCB is a byproduct or impurity	3,122	0	3,122	573 - 3,122	22 - 3,122	0 - 3,122
	TOTAL FOR ALL FACILITIES	**4,103**	**9**	**3,772 - 3,776**	**778 - 3,389**	**73 - 3,308**	**3 - 3,263**

[a] Facilities expected to exceed a lower reporting threshold due to an activity, other than combustion, that results in the manufacture, process or otherwise use of hexachlorobenzene and assumed to exceed a lower reporting threshold due to combustion (and already included in the coal/oil combustion facilities estimate) have been subtracted from the total facilities estimated to report due to non-combustion activities to avoid double counting.

C.4 CONCLUSIONS

As a result of lowering the TRI reporting thresholds, an estimated additional 3 to 3,776 reports may be anticipated for hexachlorobenzene, depending on the reporting threshold. The estimated number of reports at each threshold is presented below:

1 lb/yr - 3,772 - 3,776
10 lbs/yr - 778 - 3,389
100 lbs/yr - 73 - 3,308
1,000 lbs/yr - 3 to 3,263

LITERATURE CITED

1. Agency for Toxic Substances and Disease Registry (1990). Public Health Statement. http://atsdr1.atsdr.cdc.gov:8080/ToxProfiles/phs9017.html. Downloaded 12/3/97.

2. Aluminum Association, The (1998). Memorandum to Robert Bailey (Bailey Associates) regarding a review of the draft report "Global Hexachlorobenzene Emissions". April 29, 1998.

3. British Horological Institute (ND). Poisons and Horological Materials. http://www.bhi.co.uk/hints/poison.htm.

4. Eastern Research Group (1998). Survey of Facilities Reporting to TRI Under SIC 5169. June.

5. Knutzen, J. and M. Oehme (1989). "Polychlorinated Dibenzofuran (PCDF) and Dibenzo-p-dioxin (PCDD) Levels in Organisms and Sediments from the Frierfjord, Southern Norway (1989)." Chemosphere, Volume 18, Number 12.

6. Kroschwitz, I. ed. (1994). Kirk-Othmer's Encyclopedia of Industrial Chemicals. 4th ed. John Wiley and Sons. New York. 1994.

7. New Jersey Department of Health (1988). Hazardous Substances Fact Sheet: Hexachlorobenzene.

8. PEI Associates, Inc. (1985). Sources of Hexachlorobenzene, John Spessard, Contract No. 68-02-4248.

9. Spectrum Laboratories (ND). Chemical Fact Sheet. http://www.speclab.com/compound/c118741.htm

10. Spectrum Laboratories (ND). Chemical Fact Sheet. http://www.speclab.com/compound/c127184.htm

11. U.S. Census Bureau. 1992 Census of Manufactures - Industry Series. Department of Commerce

12. U.S. Census Bureau. 1995 County Business Patterns.

13. U.S. EPA (1997a). RCRA Biennial Reporting System (BRS) for Hazardous Waste. Office of Solid Waste. 1995.

14. U.S. EPA (1997b). 1995 Toxics Release Inventory (TRI) Database. Office of Pollution Prevention and Toxics.

15. U.S. EPA (1997c). Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313. Office of Pollution Prevention and Toxics. April.

16. U.S. EPA (1997d). 1990 Emissions Inventory of Section 112 (c)6 Pollutants . Emissions, Monitoring and Analysis Division and Air Quality Strategies and Standards Division. Research Triangle Park, North Carolina. June.

17. U.S. EPA (1998). 1996 Toxics Release Inventory (TRI) Database. Office of Pollution Prevention.

18. U.S. EPA (1986). Final Draft Report - Exposure Assessment for HCB. Office of Toxic Substances, May 14.

19. U.S. EPA (1993). Estimation of National Hexachlorobenzene Emissions for 1990, Final Report. Office of Air Quality Planning and Standards, October.

20. U.S. EPA (1984). Sources of Polychlorinated Styrenes in the Great Lakes and their Tributaries. U.S. EPA Grant No. R00-5764-01.

21. Verschueren, K. (1983) Handbook of Environmental Data on Organic Chemicals, 2nd Edition (1983). Van Nostrand Reinhold, New York.

22. Westberg, H. et al. (1997). Emissions of Some Organo-chlorine Compounds in Experimental Aluminum Degassing with Hexachloroethane. Applied Occupational and Environmental Hygiene 12(3): 178-183. March.

PERSONAL COMMUNICATIONS

1. International Magnesium Association, McLean, Virginia. Telephone call regarding the electrolytic production of metallic magnesium using carbon electrodes. August 19, 1998.

APPENDIX D
MERCURY AND MERCURY COMPOUNDS

D.1 CHEMICAL PROFILE

Mercury (CAS 7439-97-6) is a heavy, silver-white metal that exists as a liquid at ambient temperatures. It is a precious metal used primarily in chlor-alkali production, wiring devices, switching mechanisms, amalgam dental fillings, and measurement and control instruments. Industries also manufacture and process mercury reagents, catalysts, and medicinal chemicals. Metal ores, coal, crude oil, and fuel oils contain mercury as a trace constituent. Despite industry efforts to reduce mercury use, federal bans on mercury additives in paints and pesticides, and increased state regulation, U.S. industrial demand exceeded 800,000 pounds in 1996 (EPA, 1997b).

D. 1. 1 PRODUCTION

Primary mining of mercury ore at the McDermitt mine in Nevada produced 986,000 pounds of mercury per year until operations ceased in 1990. Although mercury ore mining has been discontinued, mercury is produced as a byproduct of gold ore mining operations at six gold mines located in Utah, California, and Nevada (EPA, 1997b).

Secondary production of mercury involves the recovery of liquid mercury from dismantled equipment and mercury recovery from scrap and industrial wastes using a thermal or chemical extractive process. Major sources of recycled or recovered mercury include scrap from instrument and electrical manufactures (lamps and switches), wastes and sludge from laboratories and electrolytic refining plants, mercury batteries, and dental amalgams. An estimated 984,000 pounds of mercury were recovered or recycled in 1996 (EPA, 1997b).

D. 1. 2 USES

Chlor-alkali production using the mercury cell process accounts for the largest percentage of commercial consumption of mercury. However, the amount of chlorine produced using the mercury cell process has declined significantly over the past 20 years, and mercury processed during chlor-alkali production has declined proportionately. This decline is due to the chlor-alkali industry favoring a membrane cell process that uses no mercury, is more energy-efficient, and produces mercury-free products.

Mercury is commonly used in the production of electrical apparatus, including electrical switches, thermal sensing devices, fluorescent and HID lamps, tungsten bar sintering, and copper foil. Since the 1960s, the electrical apparatus manufacturing industry has primarily used mercury as an electrical contact in electric switches production. The consumption of mercury in switch manufacture has decreased from 310,000 pounds in 1989 to 98,000 pounds in 1996 due primarily

to a shift to solid state technologies. Thermal-sensing instruments use the expansion force of mercury as the instrument is heated to activate controls. Mercury vapor is injected into fluorescent lamps during manufacturing. Mercury is used in tungsten bar sintering to determine the density of tungsten in the bars. High-purity copper foil is produced in a process that requires mercury as a continuous electrical contact (EPA, 1997e).

In 1995, over 94,000 pounds of mercury were used in the manufacture of measurement and control instruments. Because mercury has uniform volume expansion in liquid form and a high surface tension, it is used in temperature- and pressure-sensing devices as well as navigational instruments (EPA, 1997e).

An estimated 550,000 pounds of mercury were used in the production of mercuric oxide, zinc-carbon, and alkaline batteries in 1989. Mercury was used in the cathodes of mercuric oxide batteries and as corrosion inhibitor in alkaline and zinc-carbon batteries. As a result of technological advances and the enactment of the "Mercury-Containing Rechargeable Battery Act" in 1996, the use of mercury in battery manufacturing was reduced to 1,200 pounds in 1996 (EPA, 1997e).

D. 1. 3 RELEASES

Of the estimated 316,000 pounds of mercury released annually into the atmosphere by anthropogenic sources in the U.S., approximately 87% (275,400 pounds) is from high-temperature waste or fossil fuel combustion point sources, approximately 10% (31,200 pounds) is from manufacturing point sources, approximately 2% (6,800 pounds) is from area sources, and approximately 1% (2,800 pounds) is from miscellaneous sources (EPA, 1997b). Table D-1 presents the 1994-1995 national mercury emission rates by point source category.

TABLE D-1
BEST POINT ESTIMATES OF 1994-1995 NATIONAL EMISSION RATES BY CATEGORY

Sources of Mercury[a]	1994-1995 tons/yr[b]	1994-1995 lbs/yr[b]	% of Total Inventory[b]
Area Sources	**3.4**	**6,800**	**2.2**
Lamp breakage	1.5	3,000	1.0
General laboratory use	1.1	2,200	0.7
Dental preparation	0.7	1,400	0.4
Landfills	0.08	160	0.1
Mobile sources	c	c	c
Paint use	c	c	c
Agricultural burning	c	c	c

TABLE D-1
BEST POINT ESTIMATES OF 1994-1995 NATIONAL EMISSION RATES BY CATEGORY

Sources of Mercury[a]	1994-1995 tons/yr[b]	1994-1995 lbs/yr[b]	% of Total Inventory[b]
Point Sources	**154.7**	**309,400**	**97.8**
Combustion Sources	**137.7**	**275,400**	**86.9**
Utility boilers	51.8	103,600	32.8
Coal	(51.6)[d]	(103,200)	(32.6)
Oil	(0.2)	(400)	(0.1)
Natural Gas	(<0.1)	(<200)	(0.0)
Municipal waste combustors[a]	29.6	59,200	18.7
Commercial/Industrial boilers	28.4	56,800	17.9
Coal	(20.7)	(41,400)	(13.1)
Oil	(7.7)	(15,400)	(4.9)
Medical waste incinerators[a]	16.0	32,000	10.1
Hazardous waste combustors[e]	7.1	14,200	4.4
Residential boilers	3.6	7,200	2.3
Coal	(3.2)	(6,400)	(2.0)
Oil	(0.5)	(1,000)	(0.3)
Sewage sludge incinerators	1.0	2,000	0.6
Wood-fired boilers[f]	0.2	400	0.1
Crematories	<0.1	1	0.0
Manufacturing Sources	**15.6**	**31,200**	**10.0**
Chlor-alkali	7.1	14,200	4.5
Portland cement[e]	4.8	9,600	3.1
Pulp & paper manufacturing	1.9	3,800	1.2
Instruments manufacturing	0.5	1,000	0.3
Secondary Hg production	0.4	800	0.3
Electrical apparatus	0.3	600	0.2
Carbon black	0.3	600	0.2
Lime manufacturing	0.1	200	0.1
Primary lead	0.1	200	0.1
Primary copper	<0.1	<200	0.0
Fluorescent lamp recycling	<0.1	<200	0.0
Batteries	<0.1	<200	0.0
Primary Hg production	c	c	c
Mercury compounds	c	c	c
Byproduct coke	c	c	c
Refineries	c	c	c
Miscellaneous Sources	**1.4**	**2,800**	0.9
Geothermal power	1.4	2,800	0.9
Turf products	g	g	g
Pigments, oil, etc.	g	g	g
TOTAL	**158**	**316,000**	**100**

Source: EPA,1997b.

[a] EPA has finalized emissions guidelines for these source categories which will reduce mercury emissions by at least 90% over 1995 levels.

[b] Numbers do not add exactly due to rounding.

[c] Insufficient information to estimate 1994-1995 emissions.

[d] Parentheses denote subtotal within larger point source category.

[e] For the purpose of this inventory, cement kilns that burn hazardous waste for fuel are counted as hazardous waste combustors.

[f] Includes boilers only; does not include residential wood combustion (wood stoves).

[g] Mercury has been phased out of use.

Mercury exists naturally as a trace contaminant in fossil fuels and municipal waste streams. When these materials are combusted, the mercury and mercury compounds vaporize due to the elevated temperature and are released into the combustion gas exhaust. Of the estimated 275,400 pounds of mercury that were emitted from combustion point sources in 1995, 91% is attributable to utility boilers (103,600 pounds), municipal waste combustors (59,200 pounds), commercial/ industrial boilers (56,800 pounds), and medical waste incinerators (32,000 pounds). The remaining 9% was released by hazardous waste combustors (14,200 pounds), residential fossil fuel boilers (7,200 pounds), sewage sludge incinerators (2,000 pounds), wood-fired boilers (400 pounds) and crematories (1 pound) (EPA, 1997b). Of the combustion point sources listed above, utility boilers, industrial boilers, and hazardous waste combustion boilers are likely to be operated at facilities subject to TRI reporting.

Manufacturing point sources emit an estimated 31,200 pounds of mercury annually, approximately 88% of which is attributable to chlor-alkali production (14,200 pounds), Portland cement manufacturing (9,600 pounds), and pulp and paper manufacturing (3,800 pounds). Geothermal power plants accounted for all of the 2,800 pounds of mercury emitted from miscellaneous sources in 1995. Mercury emissions at these plants result from off-gas ejectors and cooling towers. Geothermal power plants are not expected to report under the TRI program.

D.2 CURRENT TOXICS RELEASE INVENTORY (TRI) STATUS

Mercury and mercury compounds are currently listed on the Toxic Release Inventory (TRI). Facilities are currently required to report for mercury or mercury compounds if the facility manufactures or processes 25,000 pounds per year (lbs/yr) or more of the chemical or chemical compounds, or otherwise uses 10,000 lbs/yr or more. Currently, facility activities that process or otherwise use mercury or mercury compounds in mixtures or trade name products below the *de minimis* level are exempt from TRI reporting, unless a mercury byproduct or waste is manufactured. The current *de minimis* concentration for mercury is 1.0 percent.

Tables F-2a and F-2b present the number of TRI reports submitted in 1996 for mercury and mercury compounds, respectively. The TRI reporting requirements allow a facility manufacturing, processing or otherwise using both mercury and mercury compounds to file a single report. With respect to Section 8.1 releases, a total of 24,017 pounds of mercury and 23,920 pounds of mercury compounds releases was reported in 1996. Under Section 8 (8.1-8.8) a total of 860,054 pounds of mercury and 79,855 pounds of mercury compounds was reported. Section 8 includes releases, energy recovery, recycling, treatment, and one-time releases (EPA, 1998).

TABLE D-2a
SUMMARY OF TRI REPORTING FOR MERCURY, 1996

Industry and SIC Code	TRI Activity	Number of Form Rs	Number of Form As
Chemicals and Allied Products (SIC Code 28)	Manufacture (import), Process, Otherwise use	12	0
Petroleum and Coal Products (SIC Code 29)	Manufacture and Otherwise use	1	0
Fabricated Metal Products (SIC Code 34)	Process	1	0
Electronic and Other Electric Equipment (SIC Code 36)	Manufacture (import) and Process	3	0
Transportation Equipment (SIC Code 37)	Process	0	1
Instruments and Related Products (SIC Code 38)	Process	1	0
No SIC Reported		2	0
Total (SIC Codes 20 - 39)		**20**	**1**

Source: EPA, 1998

TABLE D-2b
SUMMARY OF TRI REPORTING FOR MERCURY COMPOUNDS, 1996

Industry and SIC Code	TRI Activity	Number of Form Rs	Number of Form As
Paper and Allied Products (SIC Code 26)	Otherwise use	1	0
Chemicals and Allied Products (SIC Code 28)	Manufacture (import), Process, Otherwise use	6	0
Rubber and Miscellaneous Plastic Products (SIC Code 30)	Process or Otherwise use	1	0
Primary Metals Industry (SIC Code 33)	Manufacture, Process and Otherwise use	3	0
Electronic and Other Electric Equipment (SIC Code 36)	Manufacture (import) and Process	1	0
No SIC Reported		1	0
Total (SIC Codes 20 - 39)		**13**	**0**

Source: EPA, 1998

Beginning with reporting year 1998, seven additional industry groups (outside of SIC codes 20 through 39) are subject to TRI reporting requirements. These industries include SIC code 10, metal mining; SIC code 12, coal mining; SIC codes 4911, 4931, and 4939, electric utilities; SIC code 4953, hazardous waste treatment and disposal facilities; SIC code 5169, chemicals and allied products - wholesale; SIC code 5171, petroleum bulk stations and terminals; and SIC code 7389, solvent recovery services. (EPA, 1997d; EPA, 1987)

These industries were reviewed to determine if they would be expected to report to TRI for mercury or mercury compounds at the current thresholds. Table D-3 presents the expansion industries and information concerning reports expected at current and lowered reporting thresholds for mercury and mercury compounds.

TABLE D-3
MERCURY AND MERCURY COMPOUNDS REPORTING FOR EXPANSION INDUSTRIES

Expansion Industry	Reports Expected at Current Thresholds	Additional Reports Expected at Lowered Threshold
Metal Mining	None expected	Mercury is a trace constituent in metal ores; additional reports are expected only if the *de minimis* concentration is eliminated.
Coal Mining	None expected	Mercury is a trace constituent in coal; additional reports are expected only if the *de minimis* concentration is eliminated.
Electric Utilities	One report expected	Mercury is a trace constituent in coal, No. 2 fuel oil, and No. 6 fuel oil; additional reports are expected.
Commercial Hazardous Waste Treatment Facilities	Unknown	Mercury is present in the wastes handled at hazardous waste treatment facilities; additional reports are possible.
Chemical and Allied Products — Wholesale	None expected	Mercury and mercury compound products may be distributed through wholesale facilities; additional reports are possible.
Petroleum Bulk Stations and Bulk Terminals	None expected	Mercury is a trace constituent in the crude oil, No. 2 fuel oil, and No. 6 fuel oil; additional reports are expected only if the *de minimis* concentration is eliminated.
Solvent Recovery Services	None expected	Mercury is present in waste streams received by solvent recovery facilities; additional reports are possible.

Source: EPA, 1997d

D.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS

This section presents estimates of additional TRI reports that may be submitted for mercury and mercury compounds, under the lower reporting threshold of 1 pound; 10 pounds; 100 pounds; and 1,000 pounds. The following estimates also assume the *de minimis* exemption would be eliminated; thus, TRI reporting is expected from facilities manufacturing, processing, or otherwise using mercury and/or mercury compounds above the lower threshold levels, regardless of the concentration.

D. 3. 1 ANALYTICAL METHODS

The following subsections describe the procedures used to estimate the number of facilities required to submit TRI reports by SIC code at the lower reporting thresholds when the *de minimis* exemption is eliminated.

Industries Not Expected to Submit Additional TRI Reports

Two industry groups, SIC codes 2812 and 285, are not expected to submit additional TRI reports under the final rule. Facilities in SIC code 2812 (alkalies and chlorine) include chlor-alkali manufacturing facilities, some of which use a mercury cell process. There are 14 chlor-alkali plants in the U.S. using the mercury cell process (EPA, 1997b), all of which submitted TRI reports in 1995 (EPA, 1995a). It is assumed that facilities submitting reports in 1995 will continue to exceed current reporting thresholds and will submit a mercury or mercury compound report annually; therefore, the final rule is not expected to result in additional reports from chlor-alkali facilities.

The paints, varnishes, lacquers, enamels, and allied products industry (SIC code 285) submitted one report for TRI in 1995 (EPA, 1995a). The industry eliminated the use of mercury in paints in 1992; therefore, additional reports are not expected. (EPA, 1997b)

Metal Mining (SIC Code 10)

The metal mining industry processes mercury as a trace constituent in metal ores. Mercury is also recovered as a byproduct from gold ores. The following steps were taken to estimate the number of metal mines that may submit additional TRI reports at lower reporting thresholds:

- Determine amount of metal ore produced by each four-digit SIC code;
- Estimate the typical mercury content in each ore;
- Divide each four-digit SIC code into employee size groups;
- Determine the number of facilities currently operating which are represented by each employee size group;
- Estimate percentage of industry activity for each employee size group by using the value of shipments and receipts;

- Estimate ore production per employee size group by applying the percentage of industry activity;
- Determine the average amount of ore produced at each facility within each employee size group;
- Using the typical mercury content in the metal ore, estimate the mercury usage per facility within an employee size group;
- Determine whether or not the lower reporting thresholds are exceeded by the average facility within an employee size group;
- Determine the total number of facilities that may submit additional TRI reports at each threshold by four-digit SIC code.

Since domestic mercury mining operations ceased in 1990, the mining of gold ores is the only source of elemental mercury generation. In 1992, gold ore mining produced 70 tons of mercury byproduct (EPA, 1997b). Currently, only six gold mine facilities generating a mercury byproduct are in operation (EPA, 1997b). Specific facility data are not available; the analysis assumes the activity usage (i.e., the amount manufactured, processed or otherwise used) for each facility exceeds the 1,000 pounds per year threshold, based on total industry activity.

The mercury activity usage for the metal mining industries is based on the metal ore production (U.S. Geological Survey, 1998a; U.S. Geological Survey, 1996; Dobra, 1997) and an estimated concentration of mercury for each metal ore type (U.S. Geological Survey, 1998b). Metal ore production data available was classified by SIC code using available literature (EPA, 1995c; EPA, 1987). For SIC code 1061, the ore production data include molybdenum and nickel metal ores; for SIC code 1099, the ore production data include antimony, beryllium, palladium, platinum and rare-earth metal ores. The metal ore production values used for calculations were 4,300 million pounds of copper ore (U.S. Geological Survey, 1998a), 2,329 million pounds of lead and zinc ores (U.S. Geological Survey, 1998a), 708 thousand pounds of gold ores (U.S. Geological Survey, 1996), 3,200 thousand pounds of silver ores (Dobra, 1997), and 146 million pounds of ores classified in SIC codes 1061 and 1099 (U.S. Geological Survey, 1996).

The mercury content in metal ores varies from one mining facility to another; the estimated concentrations are based on a common range. The mercury content in zinc, gold, and copper ores can range between 0.1 to 10 ppm, 0.1 - 1,000 ppm and 0.01 to 1 ppm, respectively (U.S. Geological Survey, 1998b). These concentrations fall below the current *de minimis* level for mercury in mixtures and trade name products. No concentration data were available for lead, silver, ferroalloy, and miscellaneous metal ores. The mercury content in zinc ores was used for lead ores; the mercury content in gold ores was used for silver ores. Finally, the mercury content in copper ores was used for ferroalloy ores, except vanadium (SIC code 1061) and miscellaneous metal ores (SIC code 1099).

Using the *1992 Census of Manufactures* (Department of Commerce, 1992c), each mineral ore (SIC code) was divided into activity groups based on the number of employees. Each employee size group represents a certain number of facilities. These facility numbers were updated using more recent information (Department of Commerce, 1995). Only facilities with 10 or more employees were considered for the analysis, since this is a criteria for TRI reporting. Assuming

production is proportional to the value of shipments and receipts (Department of Commerce, 1992c), the production capacity was estimated for each employee size group. Using the mercury concentrations in ores, the mercury activity for each employee size group and the mercury usage per facility was determined, as shown in Table D-4. Below are sample calculations for copper ore facilities in the employee size group 10 - 249.

- Determine total copper ore production and estimated mercury content in the ore.
  Annual copper ore production: 4,300 million lbs (U.S. Geological Survey, 1998a)
  Mercury content in copper ore: 0.01 to 1 ppm (U.S. Geological Survey, 1998b)
  Use 0.5 ppm (average) for calculations
- Determine the number of facilities in an employee size group
  Copper ores (SIC code 1021) employee size group 10-249 represents 27 of 46 total facilities (i.e., 59%) (Department of Commerce, 1992c)
  Apply this percentage to more recent facility numbers:
  35 total facilities in SIC code 1021 (Department of Commerce, 1995)
  59% of 35 facilities = 21 facilities in employee size group 10-249
- Estimate the percentage of copper ore mining industry production which is attributed to facilities represented by employee size group 10-249
  Copper ore mining industry (SIC code 1021) total shipments and receipts are valued at $1720.6 million with facilities represented by employee size group 10 - 249 having shipments and receipts valued at $190.9 million (Department of Commerce, 1992c).
  Estimated percentage of copper ore production attributed to facilities represented by employee size group 10-249:
  $190.9 / 1720.6 \times 100\% = 11\%$
- Estimate the average copper ore production at facilities represented by employee size group 10-249
  Total copper ore production attributed to facilities represented by employee size group 10-249: 11% of 4,300 million pounds of copper ores
  = 477 million pounds of copper ore
  The average copper ore production at each of the 21 facilities represented by employee size group 10-249: 477 million pounds/21 facilities
  = 22.7 million pounds
- Estimate the amount of mercury processed through each facility:
  0.5 lbs mercury/ 10^6 lbs copper ore × 22.7 million lbs/yr of copper ore = 11 lbs/yr
- Evaluate if the lower reporting thresholds are exceeded:
  The 10 lb/yr threshold would be exceeded by the 35 facilities represented by copper ore (SIC code 1021) employee size group 10 - 249.

Table D-4 presents the results of the analysis by employee size group for all the four-digit SIC codes in the metal mining industry (SIC code 10) reportable to TRI. The amount of mercury usage calculated for gold mines was assumed to not include the mercury byproduct recovered from six of the gold mining facilities.

TABLE D-4
POTENTIAL TRI REPORTING AT LOWER THRESHOLD FOR METAL MINING

Employee Size Group	Number of Facilities Represented by Group[a]	Estimated % of Industry Activity[b]	Estimated Hg Activity Per Facility (lb/yr)
Copper Ores (SIC Code 1021)			
10 - 249	21	11	11
250 - 499	6	10	36
500 - 999	6	50	179
1000 - 2499	2	29	312
TOTAL SIC Code 1021	35		
Lead and Zinc Ores (SIC Code 1031)			
10 - 49	9	21	272
50 - 499	16	79	575
TOTAL SIC Code 1031	25		
Gold Ores (SIC Code 1041)			
10 - 19	27	1	0
20 - 49	24	3	0
50 - 99	16	6	1
100 - 249	24	27	4
250 - 999	6	38	22
1000 - 2499	2	24	42
Byproduct Mercury Facilities	6	NA	>1,000
TOTAL SIC Code 1041	105		
Silver Ores (SIC Code 1044)			
10-499	7	98	182
TOTAL SIC Code 1044	7		

TABLE D-4
POTENTIAL TRI REPORTING AT LOWER THRESHOLD FOR METAL MINING

Employee Size Group	Number of Facilities Represented by Group[a]	Estimated % of Industry Activity[b]	Estimated Hg Activity Per Facility (lb/yr)
Ferroalloy Ores, except Vanadium (SIC Code 1061) Miscellaneous Metal Ores (SIC Code 1099)			
10 - 19	17	1	0
20 - 99	22	8	0
100 - 999	10[c]	84	6
TOTAL SIC Code 1061 & 1099	49		

NA - not applicable
[a] Number of *1995 County Business Pattern* facilities expected to fall in this employee size group, using ratio of number of facilities represented by each employee size group in the *1992 Census of Manufactures.*
[b] Based on the value of shipments and receipts (Department of Commerce, 1992c).
[c] The distribution of the 10 facilities exceeding the 1- pound threshold between SIC code 1061 and SIC code 1099 is not known. Each SIC code (1061 and 1099) were assumed to have five facilities exceed the 1 lb/yr of mercury reporting threshold.

The estimates of mercury facility activity for each metal ore employee size group were compared to the lower reporting thresholds. The results by four-digit SIC code for each threshold are presented at the end of this section in Table D-12.

In addition, no metal mining facility is expected to report for mercury at the current thresholds. The mercury content in the metal ores falls below the *de minimis* concentration. The *de minimis* exemption does not apply to gold ore mining facilities manufacturing a mercury byproduct; however, the economic analysis for industry expansion did not predict reports for processed constituents in the gold ore and did not predict TRI reports for mercury (EPA, 1997d).

Coal Mining (SIC Code 12)

Coal mining industry facilities in SIC code 12, except coal mining services (SIC code 1241), are required to report if they manufacture, process or otherwise use listed toxic chemicals above threshold quantities. However, coal extraction activities are exempt from all Section 313 reporting requirements. Extraction does not include beneficiation, coal preparation, mineral processing, *in situ* leaching or further activities. Facilities performing these non-exempt activities may be required to report for processing mercury, which is a trace constituent in the coal. The following steps were taken to estimate the number of coal mines expected to submit additional TRI reports for mercury at lower reporting thresholds:

- Determine the total annual domestic coal production;
- Determine a typical concentration of mercury in coal;
- Determine the number of facilities subject to TRI reporting in SIC code 12;

- Estimate the mercury processed through each reportable facility; and
- Estimate whether the lower reporting thresholds are exceeded.

The industry produced (extracted) 1,032,974,000 tons of coal in 1995 (Department of Energy, 1995). In this analysis, it is assumed that all the coal extracted is handled by facilities subject to TRI reporting. There are 321 coal preparation plants in the U.S. with ten or more employees (EPA, 1997d).

Using a mercury content in coal of 0.21 ppm (EPA, 1997e), the annual amount of mercury processed via coal preparation is 433,849 pounds. This content is below the current *de minimis* concentration for TRI reporting; however, this analysis assumes the *de minimis* exemption will be eliminated for mercury. Distributing mercury usage evenly across all 321 facilities results in more than 1,000 pounds of mercury usage per year for each site. Therefore all facilities will exceed each lower reporting threshold.

Pulp Mills (SIC Code 261)

Pulp mills receive mercury through the incoming wood, process water, and chemicals (e.g., chlorine produced by the mercury cell process) containing mercury impurities as well as through on-site wood combustion. Mercury contained in process water is exempt from TRI reporting. Two facilities currently submit TRI reports for mercury (EPA, 1995a). The following steps were taken to estimate the number of pulp mills expected to submit additional TRI reports for mercury at lower reporting thresholds:

- Determine the total mercury emissions for use as a minimum industry activity;
- Estimate the number of facilities that manufacture, process or otherwise use mercury;
- Estimate the minimum mercury quantity (based on emissions) processed through each facility; and
- Evaluate whether the lower reporting thresholds are exceeded.

Mercury is primarily introduced as an impurity in chlorine manufactured by the chlor-alkali process. The total amount of mercury impurities passing through pulp mills is not known; however, the industry mercury air emissions may be used as an estimate of the minimum mercury usage at pulping facilities. Mercury air emissions are estimated to be 3,800 pounds per year and primarily occur during chemical recovery operations (EPA, 1997b). There are 153 pulp mills in the U.S. burning fuel for chemical recovery (EPA, 1997e). Assuming all mercury emissions are attributable to chemical recovery operations and each facility emits the same amount of mercury, the minimum activity level for each facility is:

(3,800 lbs/yr) / 153 facilities = 25 lbs/yr

Therefore, the 153 pulp mills may submit TRI reports for mercury at a lower reporting threshold of 1 or 10 pounds per year.

Industrial & Inorganic Chemicals (SIC Code 28)

The industrial and inorganic chemical industry includes the manufacture, process, or otherwise use of mercury or mercury compounds in chlor-alkali manufacturing, inorganic or organic mercury compound production as reagents or catalysts, custom compound resins manufacture, plastic materials and resin manufacture, antiseptics, skin preparations, diuretics production, and carbon black production (discussed separately). The following steps were taken to estimate the number of facilities expected to submit additional TRI reports for mercury or mercury compounds at lower reporting thresholds:

- Determine the total industry usage of mercury or mercury compounds;
- Estimate the number of facilities manufacturing, processing, or otherwise using mercury or mercury compounds;
- Determine the average mercury usage per facility; and
- Evaluate the number of facilities exceeding the lower reporting thresholds.

The amount of inorganic mercuric reagents and catalysts manufactured or processed (SIC code 281) is based on laboratory usage, which totals 52,800 pounds per year (EPA, 1997e). Facilities are assumed to process or manufacture more than 1,000 pounds annually, based on the fact that four facilities currently report to TRI. There are a minimum of four additional facilities producing inorganic mercury compounds or processing mercury/ mercury compounds. In 1995, four reports for mercury and mercury compounds were submitted to TRI by facilities in SIC Code 281, excluding chlor-alkali facilities; however, the facilities currently reporting to TRI are not the same as those listed in the *Mercury Study Report to Congress* (EPA, 1997b). Therefore, four additional facilities may submit TRI reports at each or the lower reporting thresholds.

Estimates of the number of additional facilities expected to submit TRI reports for mercury or mercury compounds in SIC codes 282, 283, and 286 are based on facilities reporting a "mercury" waste in the Biennial Reporting System (BRS) database. The 1995 BRS GM Form Summary for mercury lists a total of 7,233 forms submitted by 4,174 facilities (EPA, 1998). On average, each facility submitted:

7,233 forms/4,174 facilities = 1.7 forms per facility

For the plastic materials and synthetic resin industry (SIC code 282), drug manufacturing industry (SIC code 283) and industrial organic chemical industry (SIC code 286), a total of 141, 306 and 218 reports were submitted, respectively. Using the average factor of 1.7 forms per facility, an estimate for the number of facilities reporting a "mercury" waste was determined. The sample calculation for SIC code 282 is shown below:

Number of reports submitted: 141 reports
Number of facilities: 141 reports / (1.7 reports/facility) = 83 facilities

Because the amount of mercury or mercury compounds manufactured, processed or otherwise used is not known, all facilities reporting a "mercury" waste to the BRS in 1995 are estimated to report at each of the lower reporting thresholds.

Carbon Black Production (SIC Code 2895)

The oil feedstock used for the production of carbon black contains traces of mercury. The following steps were taken to estimate the number of facilities expected to submit additional TRI reports for mercury at lower reporting thresholds:

- Determine the number of carbon black facilities and their corresponding capacities;
- Determine a typical concentration of mercury in crude oil;
- Estimate the mercury processed through each facility; and
- Evaluate the number of facilities exceeding the lower reporting thresholds.

There are 24 carbon black production facilities in the U.S.; their facility capacities (EPA, 1997e) are listed in Table D-5. The mercury content in crude oil is 6 ppm (EPA, 1997d). This concentration was applied to each facility capacity. A sample calculation for Facility #1 is shown below.

Facility #1 Capacity = 355,000,000 lbs/yr (EPA, 1997e)

Annual Mercury Usage: (355,000,000 lbs/yr) × (6 lbs mercury/ 10^6 lbs crude oil)

= 2,130 lbs/yr

Table D-5 also presents the estimated mercury usage for all 24 carbon black facilities.

All 24 facilities may submit additional reports for mercury at a reporting threshold of 1 pound per year. At a lower reporting threshold of 10 pounds per year, 22 facilities may submit additional TRI reports for mercury. Twenty-one facilities may report at a threshold of 100 pounds per year, and 11 facilities may submit additional reports at a threshold of 1,000 pounds per year.

Currently, no carbon black facilities (SIC code 2895) submit TRI reports for mercury (EPA, 1995a). The mercury concentration of 6 ppm falls below the current *de minimis* level.

TABLE D- 5
MERCURY USAGE AT CARBON BLACK FACILITIES

Facility #	Capacity[a] (10^6 lbs/yr)	Estimated Mercury Usage (lbs/yr)
1	355	2130
2	65	390
3	220	1320
4	200	1200
5	20	120
6	125	750
7	195	1170
8	220	1320
9	80	480
10	80	480
11	265	1590
12	130	780
13	120	720
14	120	720
15	240	1440
16	8	48
17	190	1140
18	225	1350
19	135	810
20	1	6
21	1	6
22	265	1590
23	120	720
24	285	1710
Total		**22,000**

[a] Source: EPA, 1997e

Petroleum Refining (SIC Code 291)

Mercury is a trace constituent in crude oil. Petroleum refining facilities process or otherwise use mercury when refining crude oil. Mercury and mercury compound byproducts and impurities may also be manufactured at the facilities. The approach used to estimate the number of facilities expected to submit additional TRI reports for mercury at a lower reporting threshold was to:

- Determine the number of facilities manufacturing, processing or otherwise using mercury or mercury compounds and the corresponding facility crude oil capacities;
- Determine a typical concentration of mercury in crude oil;
- Determine a typical density for petroleum crude oil;
- Estimate the mercury processed or otherwise used through each facility; and
- Evaluate the number of facilities exceeding the lower reporting thresholds.

There are 176 petroleum refining facilities in the U.S. (EPA, 1995e). The crude oil distillation capacity for 169 facilities (National Petroleum Refiners Association, 1995) is listed in Appendix D of *Locating and Estimated Air Emissions from Sources of Mercury and Mercury Compounds* (EPA, 1997e). For this analysis, it was assumed that facilities operate at capacity 350 days per year. The density of petroleum crude oil ranges from 6.7 to 9.0 lbs/gal, and the mercury content ranges between 0.023 and 30 ppm (EPA, 1997e). The density was assumed to be 8.345 pounds per gallon. A mercury concentration of 6 ppm (EPA,1997d) was used for the analysis. The total mercury usage for one facility was calculated as follows:

Crude oil distillation capacity: 126,000 barrels(bbl) per day
126,000 bbl/day × (42 gal/bbl) × (8.345 lbs/gal) × (6 lbs mercury/ 10^6 lbs crude oil)
× 350 day/yr = 92,740 lbs/yr mercury

The mercury usage at each facility was calculated as shown above using facility-specific distillation capacities. The mercury usage per facility ranges between 694 and 278,000 pounds per year (only one facility is below 1,000 pounds of mercury annually) for an industry total of 9,938,000 lbs/yr of mercury and mercury compounds. For the seven facilities with unknown distillation capacities, the analysis assumes each would exceed the 1,000 pounds per year reporting threshold.

Only three facilities in the petroleum refining industry submitted TRI reports for mercury and mercury compounds in 1995. Because mercury is below its *de minimis* level in the crude oil, the processing or otherwise using of mercury in crude oil is currently exempt from TRI reporting. Removing the *de minimis* level and lowering the reporting threshold to 1, 10 or 100 pounds per year may result in 173 additional facilities submitting TRI reports for mercury, and 172 additional facilities may submit TRI reports for mercury at a threshold of 1,000 pounds per year.

Portland Cement Manufacturing (SIC Code 324)

Portland cement facilities process or otherwise use mercury as an impurity in raw materials and fuels. The approach used to estimate the number of facilities that may submit additional TRI reports for mercury at a lower threshold was to:

- Determine the total mercury emissions for use as a minimum industry activity;
- Determine the number of facilities that process or otherwise use mercury;
- Estimate the minimum mercury quantity (based on emissions) processed or otherwise used through each facility; and
- Evaluate the number of facilities expected to exceed the lower reporting thresholds.

There are 118 Portland cement facilities (van Oss, 1996) that process or otherwise use mercury impurities in the raw material or fuel. The mercury air emissions at each facility ranges between 10 and 269 pounds per year and represent a minimum mercury throughput or usage, although it is likely that usage exceeds the amount of air emissions. From a trial burn report (Radian Corporation, 1995), typical mercury concentrations in cement manufacturing process streams are:

Raw mix:	< 0.01 ppm;
Waste derived fuels:	<1.5 ppm;
Clinker product:	<0.01 ppm; and
Cement kiln dust:	<0.5 ppm.

For the fuels and some process streams, the concentration of mercury falls below the current *de minimis* level. Table D-6 lists the number of facilities within each mercury usage range.

TABLE D-6
PORTLAND CEMENT FACILITIES AT EACH MERCURY USAGE RANGE

Mercury Usage[a] (lbs/yr)	Number of Facilities[b]
1 - 9	0
10 - 99	82[b]
100 - 999	36

[a] Mercury usage is based on mercury emissions at Portland cement facilities (EPA, 1997c).

[b] Emissions data were unavailable for seven facilities; they were assumed to exceed 1 and 10 pounds per year reporting threshold and have been included in the 10 - 99 lbs/yr range.

Based on the estimated mercury usage for each facility, 118 facilities in SIC code 324 may submit additional TRI reports for mercury at a reporting threshold of 1 or 10 pounds per year. At a reporting threshold of 100 pounds per year, 36 facilities may submit additional reports. No facilities are expected to submit additional reports at a lower reporting threshold of 1,000 pounds per year.

Structural Clay Products (SIC Code 3259)

Mercury is processed or otherwise used in the manufacture of certain clay products. The following steps were taken to estimate the number of facilities that may submit additional TRI reports for mercury or mercury compounds at lower reporting thresholds:

- Determine the total mercury emissions for use as a minimum industry activity;
- Determine the number of facilities manufacturing, processing, or otherwise using mercury or mercury compounds;
- Estimate the minimum mercury quantity processed through each facility; and
- Evaluate whether the lower reporting thresholds are exceeded.

Structural clay products (SIC code 3259) are manufactured at 32 facilities that have 10 or more employees (Department of Commerce, 1992a). The average facility usage is estimated to be between 1 and 10 pounds of mercury annually, based on 220 pounds of mercury emissions in 1990 (Federal Register Notices, 1998). The mercury usage per facility was calculated by distributing the emissions evenly across all facilities, as shown below:

Mercury Usage Per Facility: (220 lbs mercury/ yr)/ 32 facilities = 7 lbs/yr

Lowering the reporting threshold to 1 pound per year may result in 32 additional facilities submitting TRI reports. This analysis assumes that no facilities would submit additional TRI reports at reporting thresholds of 10, 100 or 1,000 pounds per year.

Lime Manufacturing (SIC Code 3274)

Lime manufacturing facilities process or otherwise use mercury as an impurity in limestone and fuels. The following steps were taken to estimate the number of facilities expected to submit additional reports for mercury in limestone:

- Divide the 65 facilities with 10 or more employees in SIC 3274 into employee size categories and obtain the number of facilities in each categories (U.S. Department of Commerce, 1995);
- Estimate the percentage of industry activity for each employee size category using a ratio of the total number of employees in the size category to the total number of employees in SIC 3274;
- Estimate total lime production for each size category by applying the percent of industry activity to the total annual lime production in the U.S. of 18.5 million metric tons (U.S.G.S., 1995);
- Estimate the average amount of limestone used at each facility in the size group assuming 2 pounds of limestone are used for each pound of lime produced (Kroschwitz, 1994);

- Estimate the average mercury activity per facility by applying the estimated concentration of mercury in limestone of 0.5 ppm (U.S. EPA, 1997f);
- Determine the total number of facilities that may submit TRI reports for mercury based on otherwise using mercury in the production of lime at each threshold.

For the 1-, 10- and 100- pound thresholds, EPA estimates that all 65 lime manufacturing facilities with ten or more employees may report due to mercury in limestone, and at the 1,000-pound threshold, 14 facilities are expected to report.

Steel Works, Blast Furnaces, & Rolling Mills (SIC Code 3312)

Coke production facilities process or otherwise use mercury as a trace constituent in coal. The following steps were taken to estimate the number of facilities expected to submit additional TRI reports for mercury at lower reporting thresholds:

- Identify coke production facilities and their corresponding coke production capacities;
- Estimate the percentage of total coke produced at each facility;
- Determine the total U.S. coal consumption used for coke making;
- Apply the percentage of total coke manufactured to estimate the coal consumption at each facility;
- Determine a typical concentration of mercury in coal;
- Estimate the mercury processed or otherwise used through each facility; and
- Evaluate the number of facilities exceeding the lower reporting thresholds.

There are 27 coke production facilities in the U.S. in 1995 (EPA, 1995b). In 1995, U.S. coke production was 23.75 million tons (Hogan, 1996). Specific facility capacities for coke production are listed in New Steel (Hogan, 1996). The overall industry coal consumption for coke production totals approximately 70,329 million pounds per year (Department of Commerce, 1992a).

To calculate the amount of mercury added to the steel making process from coal, a concentration of 0.21 ppm of mercury in coal was used (EPA, 1997e). This concentration is below the current *de minimis* concentration, however the de minimis exemption is eliminated under the final rule. The amount of mercury processed or otherwise used by each facility was calculated as follows:

Facility A coke production capacity: 1,920 tons of coke per day (Hogan, 1996)
Total U.S. coke production capacity: 60,255 tons of coke per day (Hogan, 1996)
Facility A percentage of coke production capacity:
1,920 tons/ 60,255 tons × 100% = 3% of total coke production capacity
U.S. coal consumption for coke production: 70,329 million pounds per year (Department of Commerce, 1992a)

Assuming coke production capacity is proportional to coal consumption,

Facility A coal usage is: 3% of 70,329 million pounds of coal per year
= 2,240 million lbs/yr

Mercury content in coal = 0.21 ppm (EPA, 1997e)

Facility A mercury usage is: 0.21 ppm × 2,240 million lbs coal/yr
= 470 lbs mercury/yr

Based on these calculations, the total mercury for the industry is estimated as 14,200 to 16,600 lbs/year, with a distribution among facilities, as shown in Table D-7.

TABLE D-7
ESTIMATED MERCURY USAGE AT COKE PRODUCTION FACILITIES BASED ON CAPACITY AND INDUSTRY COAL CONSUMPTION

Estimated Mercury Usage (lbs/yr)	Number of Facilities
< 10	0
10 - 99	1
100 - 999	23
≥ 1,000	3

Based on the estimated mercury usage for the 27 coke production facilities, all 27 facilities may submit additional TRI reports for mercury at the 1 or 10 pounds per year reporting threshold, assuming the *de minimis* exemption will not be applied. Twenty-six facilities may submit reports at the 100 pounds per year threshold, and three facilities may submit reports at the 1,000 pounds per year threshold.

Primary Smelting & Refining of Nonferrous Metals (SIC Code 3331 and 3339)

Copper and lead facilities process or otherwise use mercury as an impurity in sulfide ore. The following steps were taken to estimate the number of facilities in SIC code 3331 that may submit additional TRI reports for mercury at the lower reporting thresholds:

- Determine the amount of mercury processed in the sulfide ores annually for each facility;
- Estimate mercury usage for facilities without information available;
- Evaluate whether the lower reporting thresholds have been exceeded.

The total amount of mercury processed or otherwise used by the primary copper smelting and refining industry is estimated to be 18,000 pounds per year (EPA, 1997e). *The Mercury Study Report to Congress* (EPA, 1997b) lists seven active primary copper smelters in the U.S., along with five facilities' annual mercury content in the sulfide ores, which ranged from 585 to

5,768 pounds per year. There are no data available for two facilities. To estimate the mercury content for these facilities, an average mercury activity amount for the other five facilities was calculated to be 2,560 pounds per year.

The following steps were taken to estimate the number of facilities in SIC code 3339 that may submit additional TRI reports for mercury at the lower reporting thresholds:

- Determine the amount of lead produced at each facility;
- Determine the tons of lead produced per ton of sulfide ore;
- Estimate a typical mercury concentration in the sulfide ore; and
- Estimate the mercury usage at each facility and evaluate if the lower reporting thresholds are exceeded.

The total industry mercury usage for primary smelting and refining of nonferrous metals (SIC code 3339) is the sum of 3,500 lbs/yr for the three facilities listed in the *Mercury Study Report to Congress* (EPA, 1997b) and 188,000 pounds released or transferred from a separate facility submitting a TRI report for mercury in 1995 (EPA, 1995a).

Three facilities were performing primary lead smelting with production levels of 65,800, 125,000 and 200,000 tons of lead in 1994 (EPA, 1997b). The amount of mercury in the ore is 0.4×10^{-3} pounds of mercury per ton of ore, and for every 100 tons of ore, 4.5 tons of refined lead are produced (EPA, 1997b). The amount of mercury processed through each facility can be estimated using these two factors as shown below for the first facility:

$(0.4 \times 10^{-3}$ lbs mercury/ton ore) × (100 tons ore/4.5 tons lead)
$= 8.9 \times 10^{-3}$ lbs mercury/ton lead
Facility lead production: 65,800 tons of lead per year
Facility mercury usage: (65,800 tons lead/y)r × $(8.9 \times 10^{-3}$ lbs mercury/ton lead)
= 585 pounds mercury/yr (~ 600 lbs/yr)

The estimated mercury usages at the three facilities are 600, 1,100, and 1,800 pounds per year, respectively.

Only one facility in SIC code 3339 submitted a TRI report for mercury in 1995; however, this facility was not one of the primary lead smelters listed in the *Mercury Study Report to Congress* (EPA, 1997b). Eliminating the *de minimis* exemption, ten additional facilities in SIC code 333 may submit TRI reports for mercury at a lower reporting threshold of 1, 10 or 100 pounds per year. At a lower reporting threshold of 1,000 pounds per year, eight additional facilities may submit a TRI report for mercury.

Secondary Smelting & Refining of Nonferrous Metals (SIC Code 334)

Chemical treatment of liquid mercury or thermal treatment of metallic mercury scrap results in the secondary production of mercury. The following steps were taken to estimate the number of facilities expected to submit additional TRI reports for mercury or mercury compounds at lower reporting thresholds:

- Determine the total industry usage of mercury or mercury compounds;
- Estimate the number of facilities manufacturing, processing, or otherwise using mercury or mercury compounds;
- Determine the average mercury usage per facility; and
- Evaluate the number of facilities exceeding the lower reporting thresholds.

Eight facilities provide secondary mercury production services, and these facilities recycled 984,000 pounds of mercury in 1996 (EPA, 1997b). The amount of mercury usage per facility is expected to exceed 1,000 pounds per year. Only one mercury report was submitted to TRI in 1995 for a facility in SIC code 334. All seven of the remaining mercury reclamation facilities are expected to submit TRI reports at each of the lower reporting thresholds.

Fabricated Metal Products (SIC Code 34)

Mercury or mercury compounds are used as article components in coating and engraving operations (EPA, 1995a), chromium plating operations (Federal Register Notices, 1998) and copper foil production. The following steps were taken to estimate the number of facilities expected to submit additional TRI reports for mercury or mercury compounds at lower reporting thresholds:

- Estimate the number of facilities that manufacture, process, or otherwise use mercury or mercury compounds; and
- Evaluate whether facilities exceed the lower reporting thresholds.

A total of 53 reports were submitted to the Biennial Reporting System in 1995 by the coating, engraving and allied services industry (SIC code 347) (EPA, 1998). The 1995 BRS GM Form Summary for mercury lists a total of 7,233 forms submitted by 4,174 facilities (EPA, 1998). On average, each facility submitted:

7,233 forms/4,174 facilities = 1.7 forms per facility.

Using the average factor of 1.7 forms per facility, an estimate for the number of facilities in SIC code 347 reporting a “mercury” waste was determined as shown below:

Number of reports submitted: 53 reports
Number of facilities: 53 reports / (1.7 reports/facility) = 31 facilities

Because the amount of mercury or mercury compounds manufactured, processed or otherwise used is not known, facilities reporting a "mercury" waste to the BRS in 1995 are expected to report at each of the lower reporting thresholds. One facility in SIC code 347 submitted a TRI report for mercury at the current thresholds in 1995 (EPA, 1995a). Therefore, 30 facilities are expected to report at each of the lower thresholds.

Mercury is also processed during the production of copper foil. According to the *Census of Manufacturers* (Department of Commerce, 1992a), there are 39 facilities performing non-aluminum foil and leaf applications (SIC code 349). The amount of mercury usage per facility for copper foil production is unknown; therefore, all 39 facilities are assumed to submit additional mercury or mercury compounds TRI reports at each of the lower reporting thresholds.

Electronic and Other Electric Equipment (SIC Code 36)

Mercury is processed or otherwise used at electronic and electric equipment facilities as a component in bulbs, electrical switches, wiring and batteries. The following steps were taken to estimate the number of facilities expected to submit additional TRI reports for mercury or mercury compounds at lower reporting thresholds:

- Determine the total industry usage of mercury or mercury compounds;
- Estimate the number of facilities manufacturing, processing, or otherwise using mercury or mercury compounds;
- Determine the average mercury usage per facility; and
- Evaluate the number of facilities exceeding the lower reporting thresholds.

Mercury is processed at facilities in SIC code 364 as a bulb component with approximately 14 ppm of mercury per lamp (EPA, 1997b). A total of 78 electric lamp bulbs and tubes facilities have 10 or more employees (Department of Commerce, 1995a). According to the *Mercury Study Report to Congress* (EPA, 1997b) approximately 64,000 pounds per year of mercury was used in the manufacture of bulbs. With a total of 78 facilities, the average annual facility usage ranges between 100 and 1,000 pounds per year, as shown below:

(64,000 lbs mercury/yr) / (78 facilities) = 820 lbs mercury/yr per facility

Therefore, 78 additional facilities may submit TRI reports for mercury at the 1, 10 and 100 pounds per year thresholds.

Facilities in SIC code 367 process mercury as a component in electrical switches and wiring. Approximately 110,000 pounds of mercury is used annually for wiring and switches (EPA, 1997b). A total of 91 companies produce switches with shipments of $100,000 or more (Department of Commerce, 1992a). The estimated average amount of mercury processed annually by these facilities is calculated as follows:

(110,000 lbs mercury/yr) / 91 facilities = 1,208 lbs mercury/yr per facility

The mercury usage per facility is, therefore, estimated to be greater than 1,000 pounds annually. In 1995, three facilities submitted TRI reports for mercury. The analysis expects 88 facilities in SIC code 367 to submit additional TRI reports for mercury at each of the lower reporting thresholds.

Mercury is a component in mercuric oxide, zinc carbon, and alkaline batteries produced at facilities in SIC code 369. It is also used in alkaline battery casings as a side reaction inhibitor and corrosion inhibitor. The concentration of mercury in batteries depends on the battery type as shown below in Table D-8.

TABLE D-8
MERCURY CONCENTRATIONS BY BATTERY TYPE

Battery Type	Mercury Content (%)
Mercuric oxide	30 - 40
Silver oxide	1
Zinc - Air	1
Carbon - Zinc	1
Alkaline	0.025

Source: EPA, 1997b

The use of mercury in batteries has decreased by 94% between 1989 and 1992 (EPA, 1997b). Less than 1,200 pounds were used for batteries in 1995 at a total of 16 battery production facilities (EPA, 1997b). The estimated average mercury usage per facility was calculated as shown below:

1,200 lbs/yr / 16 facilities = 75 lbs/yr

Only one TRI report for mercury was submitted in 1995 for this industry. If the activity thresholds were lowered to 1 or 10 pounds per year, an additional 15 facilities may submit TRI reports for mercury.

Instruments, Related Products (SIC Code 38)

Facilities in SIC code 38 process mercury as a component in thermometers, thermostats, and dental amalgam fillings. The following steps were taken to estimate the number of facilities expected to submit additional TRI reports for mercury or mercury compounds at lower reporting thresholds:

- Determine the total industry usage of mercury or mercury compounds;
- Estimate the number of facilities manufacturing, processing, or otherwise using mercury or mercury compounds;
- Determine the average mercury usage per facility; and
- Evaluate the number of facilities exceeding the lower reporting thresholds.

Lab apparatus and instruments manufacturing facilities in SIC code 382 process approximately 94,600 pounds of mercury annually (EPA, 1997b). To determine the number of facilities processing mercury, the Biennial Reporting System report for 1995 was used. A total of 56 reports were submitted to the Biennial Reporting System in 1995 by facilities in SIC code 382 (EPA, 1998). The 1995 BRS GM Form Summary for mercury lists a total of 7,233 forms submitted by 4,174 facilities (EPA, 1998). On average, each facility submitted:

7,233 forms/4,174 facilities = 1.7 forms per facility.

Using the average factor of 1.7 forms per facility, an estimate for the number of facilities in SIC code 382 reporting a "mercury" waste was determined as shown below:

Number of reports submitted: 56 reports
Number of facilities: 56 reports / (1.7 reports/facility) = 33 facilities

The estimated mercury usage at each facility is calculated as shown below:

(94,600 lbs mercury/yr) / 33 facilities = 2,867 lbs mercury/yr per facility

The mercury usage per facility is assumed to be greater than 1,000 pounds per year; however, the total number of facilities is not known. This analysis estimates 33 facilities may submit additional TRI reports for mercury at each of the lower reporting thresholds.

The dental equipment and supplies industry processes approximately 70,000 pounds of mercury annually (EPA, 1997e). According to the *Census of Manufactures*, nine dental equipment and supply facilities (SIC code 3843) produce dental alloys for amalgam fillings (Department of Commerce, 1992a). This results in over 1,000 pounds of mercury processed annually for each of the nine facilities, as calculated below:

(70,000 lbs mercury/yr) / 9 facilities = 7,778 lbs mercury/yr per facility

In 1995, two facilities submitted TRI reports for mercury (EPA, 1995a). By lowering the reporting threshold to 1, 10, 100, or 1,000 pounds per year, seven additional facilities may submit a TRI report for mercury.

Electric Utilities (SIC Code 4911, 4931, 4939)

Mercury present as a trace constituent in the coal and oil combusted to generate electricity may be otherwise used by electric utilities. The concentration of mercury falls below the *de minimis* concentration in coal, No. 2 fuel oil and No. 6 fuel oil.

For this analysis, electric utility facilities were grouped according to their primary fuel type. The analysis considered 390 coal, 124 oil, and 49 combined cycle electric utility facilities under SIC code 4911 (EPA, 1997d). The analysis also considered 197 coal-fired and 98 oil-fired

facilities in SIC code 4931, and 19 coal fired and 14 oil fired facilities in SIC code 4939. The estimated number of facilities in SIC code 4911 exceeding the lower reporting thresholds for mercury was based on calculating the minimum fuel throughput and the operating information on 514 utility boilers in SIC code 4911 (EPA, 1997d).

To estimate the number of facilities in SIC codes 4931 and 4939 that burn sufficient amounts of coal and/or oil to reach the lower reporting thresholds, the percentage of facilities meeting the thresholds for SIC code 4911 was applied to the total number of facilities in SIC codes 4931 and 4939. Mercury per facility per year ranged from 1.7 - 5,100 pounds for coal combusting facilities, and 0 - 25 pounds for oil combusting facilities (EPA, 1997b). A detailed analysis of mercury processed through electric utilities during coal and oil combustion is provided in Appendix A, and the analysis results are presented in Table D-9.

TABLE D-9
SIC CODE 4911, 4931, AND 4939 FACILITIES EXPECTED TO SUBMIT TRI REPORTS FOR MERCURY AT LOWER REPORTING THRESHOLDS

Threshold	Fuel Type	SIC Code 4911 Facilities	SIC Code 4931 Facilities	SIC Code 4939 Facilities
1 lb/yr	Coal	388	196	19
	Oil	32	25	4
10 lb/yr	Coal	385	194	18
	Oil	3	3	1
100 lbs/yr	Coal	328	166	16
	Oil	0	0	0
1,000 lbs/yr	Coal	122	62	6
	Oil	0	0	0

Commercial Hazardous Waste Treatment (SIC Code 4953)

Mercury present as a trace contaminant in municipal waste streams may be processed or otherwise used in commercial hazardous waste treatment. To estimate the number of commercial hazardous waste treatment facilities that may report on mercury at lower reporting thresholds, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose. First, TRI data may underestimate the *number of reporting facilities* because TRI- subject hazardous waste facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the hazardous waste facility may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities (for a total of 162 facilities), and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of hazardous waste treatment facilities at which amounts of mercury would exceed a lower reporting threshold (1, 10, 100, 1,000 lbs) were counted. Facilities exceeding current reporting thresholds were not included in this count.

Chemicals and Allied Products, Not Elsewhere Classified (SIC Code 5169)

Chemicals and allied products wholesalers may process mercury as a component in some chemical products. Facilities in SIC code 5169 have not yet submitted reports to EPA for TRI. Results of a telephone survey showed that none of the 9 facilities contacted in SIC code 5169, reported handling mercury or mercury compounds. For this analysis, 1 percent of the 717 facilities that are expected to report under the existing thresholds, or 7 facilities, are assumed to submit additional TRI reports for mercury or mercury compounds at each of the lower reporting thresholds.

Petroleum Bulk Stations and Terminals (SIC Code 5171)

Petroleum bulk stations and bulk terminals process mercury as a trace constituent in crude oil, No. 2 fuel oil, and No. 6 fuel oil (EPA, 1997d). The estimated number of facilities in SIC Code 5171 expected to submit reports for mercury at lower reporting thresholds is based on the methodology presented in Appendix H of the TRI industry expansion economic analysis (EPA, 1997d). This methodology does not consider extent to which facilities handle more than one product type containing the same PBT chemical and overestimates of the number of facilities expected to report for each chemical. Therefore, the methodology was enhanced to consider the overlap of multiple products handled by a single facility. Data on fuel throughput and chemical concentration by fuel type were used to estimate the unique number of facilities that will file reports for each PBT chemical. The estimate was based on a set of six model facilities described in the TRI industry expansion economic analysis, each characterized by its throughput of petroleum products containing at least one TRI constituent above *de minimis* levels. Each model facility is assumed to represent a number of facilities with similar fuel throughput characteristics, a given subset of which are assumed to handle each of the petroleum products. The percentage of facilities handling each petroleum product was calculated using data from the Independent Liquid Terminals Association (ILTA) directory which identifies the different combination of products handled by each member facility.

The following methodology was used to estimate the number of affected facilities represented by each of the six model facilities:

- Using available concentration data, calculate the minimum annual throughput required to exceed each of the lower reporting thresholds for mercury in each petroleum product;

- For each model facility, identify the petroleum products for which annual throughput is sufficient to exceed each of the lower reporting thresholds for mercury;
- Estimate the percentage of facilities in the ILTA directory that handle at least one of the petroleum products with sufficient throughput to exceed lower reporting thresholds for each model facility;
- Apply the percentage developed in the previous step for each model facility to number of facilities represented by that model facility to estimate the number facilities expected to submit a report for mercury; and
- Calculate the total number of facilities expected to report at each of the lower reporting thresholds by summing the number of facilities reporting for mercury across all six model facilities.

The concentration of mercury is 6 ppm in crude oil, 0.4 ppm in No. 2 fuel oil, and 0.005 ppm in No. 6 fuel oil (EPA, 1997d). These concentrations are below the current *de minimis* concentration for mercury, however this analysis does not consider the *de minimis* exemption for the processing or otherwise using of mercury in mixtures and trade name products.

Annual product sales at petroleum bulk stations and terminals is estimated at 35,609,975,000 gallons of No. 2 fuel oil, 11,017,867,000 gallons of No. 6 fuel oil, and 42,245,575,000 gallons of crude oil (Department of Commerce, 1992b). The quantity of mercury processed through these facilities totaled 1,951,210 pounds per year and was calculated as shown below. The density of No.2 fuel oil 7.05 pounds per gallon. The density for No.6 fuel and crude oil were assumed to be 7.88 and 7.3 pounds per gallon, respectively.

No. 2 fuel oil: (35,609,975,000 gal oil/yr) × (7.05 lb oil/ gal oil) × (0.4 lb mercury/1 × 10^6 lb oil) = 100,420 lbs mercury/yr

No. 6 fuel oil: (11,017,867,000 gal oil/yr) × (7.88 lb oil/ gal oil) × (0.005 lb mercury/ 1×10^6 lb oil) = 434 lbs mercury/yr

Crude oil: (42,245,575,000 gal oil/yr) × (7.3 lb oil/ gal oil) × (6 lb mercury/1 × 10^6 lb oil) = 1,850,356 lbs mercury/yr

Total Mercury Activity for SIC code 5171: 100,420 + 434 + 1,850,356 = 1,951,210 lbs/yr

To determine the number of facilities that may submit additional TRI reports for mercury at the lower reporting thresholds, the model facilities, and their corresponding annual product throughput estimates listed in the TRI industry expansion economic analysis (EPA, 1997d) was used. Table D-10 reproduces Table H-2 of that analysis which presents the annual throughputs and number of facilities represented by the model.

TABLE D-10
ANNUAL THROUGHPUT ESTIMATES AND TOTAL NUMBER OF FACILITIES BY SIC CODE 5171 MODEL FACILITIES

Product	Annual Throughput for Each Model Facility Size Category (1000 gallons/year)					
	1	**2**	**3**	**4**	**5**	**6**
Gasoline	3,750	5,100	34,500	85,000	170,000	340,000
No. 6 Fuel Oil	45	61	4,809	12,022	24,045	48,090
Crude Oil	371	505	17,862	44,655	89,317	178,623
No. 2 Fuel Oil/ Diesel	1,665	2,264	11,166	27,916	55,832	111,665
Lubricating Oils	156	213	176	441	883	1,767
Aviation Gas	17	24	161	404	808	1,616
Jet Fuel	45	62	2,738	6,847	13,694	27,389
Total Number of Facilities	**1,906**	**558**	**551**	**317**	**372**	**138**

Source: EPA, 1997d

Notes: No throughput is estimated for additives. Annual throughput for each product was calculated by multiplying the daily throughput by 340 days for bulk terminals and 300 days for bulk plants. Model facility throughputs for each product type were calculated separately and does not mean that each model facility handles all seven petroleum products. Estimates of the number of facilities and annual throughput for gasoline are based on "Model Plants" described in *Gasoline Distribution Industry (Stage I)- Background Information for Proposed Standards*. Office of Air Quality Planning and Standards (EPA-453/R-94-002a), January 1994. Model Facility 1 and 2 are based on Model Plant Numbers 4 and 5, respectively, in the *Background Information* document; and Model Facility 3,4,5, and 6 are based on Model Terminal Numbers 1,2,3, and 4.

Using the annual model throughputs above for No. 6 fuel oil, No. 2 fuel oil, and crude oil, the amount of mercury processed through each model facility was determined. The number of facilities represented by each model above that handle No. 6 fuel, No. 2 fuel, or crude oil was determined using the appropriate percentages of facilities handling each product from the ILTA survey. Table D-11 presents the results for this analysis and a sample calculation is shown below.

Model Facility No. 6 Annual Mercury Throughputs:

No. 2 fuel oil: (111,665,000 gal oil/yr) × (7.05 lb oil/ gal oil) × (0.4 lb mercury/10^6 lb oil)
= 315 lbs mercury/yr

No. 6 fuel oil: (48,090,000 gal oil/yr) × (7.88 lb oil/ gal oil) × (0.005 lb merc/10^6 lb oil)
= 2 lbs mercury/yr

Crude oil: (178,623,000 gal oil/yr) × (7.3 lb oil/ gal oil) × (6 lb mercury/10^6 lb oil)
= 7,824 lbs mercury/yr

TABLE D-11
ESTIMATED MERCURY USAGE FOR SIC CODE 5171 MODEL FACILITIES

Model				Mercury Analysis		
Model Facility Number	**Number of Facilities Represented By Each Model**	**Fuel Type**	**Annual Throughput (10^3 gal/yr)**	**% of Facilities Handling Each Fuel Type**	**Facilities Handling Each Fuel**	**Estimated Mercury Throughput Per Facility (lb/yr)**
1	1,906	No.2 Fuel Oil	1,665	55%	1,048	5
		No. 6 Fuel Oil	45	32%	610	0
		Crude Oil	371	13%	248	16
2	558	No.2 Fuel Oil	2,264	55%	307	6
		No. 6 Fuel Oil	61	32%	179	0
		Crude Oil	505	13%	73	22
3	551	No.2 Fuel Oil	11,166	55%	303	31
		No. 6 Fuel Oil	4,809	32%	176	0
		Crude Oil	17,862	13%	72	782
4	317	No.2 Fuel Oil	27,916	55%	174	79
		No. 6 Fuel Oil	12,022	32%	101	0
		Crude Oil	44,655	13%	41	1,956
5	372	No.2 Fuel Oil	55,832	55%	205	157
		No. 6 Fuel Oil	24,045	32%	119	1
		Crude Oil	89,317	13%	48	3,912
6	138	No.2 Fuel Oil	111,665	55%	76	315
		No. 6 Fuel Oil	48,090	32%	44	2
		Crude Oil	178,623	13%	18	7,824

Number of Facilities Represented by Model #6 that Handle Each Product
No. 2 Fuel Oil: 55% × 138 = 76
No. 6 Fuel Oil: 32% × 138 = 44
Crude Oil: 13% × 138 = 18

For model facility 6, mercury quantities in No.2 fuel oil, No. 6 fuel oil and crude oil exceed the 1 pound per year threshold. Therefore, facilities handling any one or combination of these three products is expected to report for mercury at the 1 pound threshold. The ILTA Directory indicates that 188 of the 311 facilities surveyed process at least one of the three products. The unique number of model 6 facilities expected to submit additional TRI reports for mercury is therefore (188 ÷ 311) x 138 = 83 facilities.

At a reporting threshold of 10 or 100 pounds per year, only the processing of No. 2 fuel oil and crude oil at model 6 facilities is expected to exceed the threshold for mercury. The ILTA Directory indicates that 179 of the 311 facilities surveyed process at least one of the two products. The unique number of model 6 facilities expected to submit additional TRI reports for mercury is (179 ÷ 311) x 138 = 79 facilities.

At a reporting threshold of 1,000 pounds per year, only the processing of crude oil is expected to trigger reporting for mercury. Therefore, unique number of model 6 facilities expected to submit additional TRI reports for mercury totals 18 facilities.

Based on the model facilities, none of the facilities in SIC code 5171 exceeds the current 25,000 pounds per year processing threshold, and none are expected to report due to the *de minimis* exemption. For each of the lower reporting thresholds, the unique number of facilities that may submit additional TRI reports for mercury were determined by adding the results for each of the models. Table D-12 lists the final ranges for this analysis at each of the lower reporting thresholds.

Solvent Recovery Services (SIC Code 7389)

Solvent recovery services may process or otherwise use mercury and mercury compounds received in waste streams. To estimate the number of solvent recyclers that may report on mercury at lower reporting thresholds, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose. First, TRI data may underestimate the *number of reporting facilities* because TRI- subject hazardous waste facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the solvent recycler may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities (resulting in a total of 191 facilities potentially subject to TRI reporting requirements), and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of solvent recyclers at which amounts of mercury would exceed a lower reporting threshold (1, 10, 100, 1,000 lbs) were counted. Facilities exceeding current reporting thresholds were not included in this count.

Combustion (SIC Codes 20-39)

Facilities performing combustion operations with coal, No. 2 distillate fuel oil, or No. 6 residual oil otherwise use mercury as a trace constituent and may generate mercury or mercury compound emissions or waste. A detailed description of the analysis is provided in Appendix A. The number of facilities that may be expected to submit additional reports for mercury due to combustion operations only or combustion and other operations are listed in Table D-12. To avoid counting facilities manufacturing, processing or otherwise using mercury in production operations and combustion operations twice, these facilities were subtracted from the two-digit SIC Code totals. Total number of facilities burning coal, distillate oil, and residual oil, has been adjusted to account for those with greater than 10 employees only and for combustion of nonprocess fuel.

Summary

Industries manufacturing, processing, or otherwise using mercury that may submit TRI reports at the lower reporting thresholds are presented in Table D-12. The number of facilities currently reporting to TRI is also provided. These facilities have exceeded the current TRI reporting threshold criteria of 10,000 pounds per year for otherwise use, or the 25,000 pounds per year for either manufacture or process. A total of 34 TRI reports were submitted in 1995 (EPA, 1995a) for mercury. One facility, with primary SIC code 2812, submitted two reports, one for mercury and one for mercury compounds. One facility in SIC code 2851, the paint industry, submitted a report in 1995, but the industry has eliminated the use of mercury. Therefore, only 32 reports from SIC codes 20-39 were relevant for this analysis of additional TRI reports at lower thresholds. One additional report is expected from the expansion industries (SIC code 4911), bringing the total number of facilities reporting to TRI for mercury at the current thresholds to 33.

Mercury and mercury compounds were considered together since facilities can file a combined report if thresholds are exceeded for both the parent metals and compounds of that same metal. This analysis assumes that facilities exceeding lower thresholds for both mercury and mercury compounds will file a single report.

TABLE D-12
SUMMARY OF ESTIMATES OF ADDITIONAL REPORTING FOR MERCURY AND MERCURY COMPOUNDS

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
1021	Copper Ores	35	0	35	35	8	0
1031	Lead & Zinc Ores	25	0	25	25	25	0
1041	Gold Ores	104	0	54	14	6	6
1044	Silver Ores	7	0	7	7	7	0
1061	Ferroalloy Ores, except Vanadium	5	0	5	0	0	0
1099	Miscellaneous Metal Ores, n.e.c.	44	0	5	0	0	0
10	**Metal Mining TOTAL**	**220**	**0**	**131**	**81**	**46**	**6**
12	Coal Mining	321	0	321	321	321	321
12	**Coal Mining TOTAL**	**321**	**0**	**321**	**321**	**321**	**321**
26	Paper and Allied Products	153	2	151	151	0	0
26	**Paper and Allied Products TOTAL**	**153**	**2**	**0**	**43[a]**	**0**	**0**
281	Industrial Inorganic Chemicals	14	14 (SIC Code 2812)	0	0	0	0
		≥ 8	4	4	4	4	4
282	Plastic Materials, Synthetic Resins, Synthetic Rubber, et al.	83	0	83	83	83	83
283	Drugs	180	0	180	180	180	180
286	Industrial Organic Chemicals	128	0	128	128	128	128
2895	Carbon Black Production	24	0	24	22	21	11

TABLE D-12
SUMMARY OF ESTIMATES OF ADDITIONAL REPORTING FOR MERCURY AND MERCURY COMPOUNDS

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
28	**Chemicals & Allied Products TOTAL**	**437**	**18**	**0[a]**	**218[a]**	**396[a]**	**405[a]**
291	Petroleum Refining and Related Industries	176	3	173	173	173	172
29	**Petroleum & Coal TOTAL**	**176**	**3**	**5[a]**	**119[a]**	**168[a]**	**172[a]**
3241	Cement, Hydraulic	118	0	118	118	36	0
3259	Structural Clay Products	32	0	32	0	0	0
3274	Lime Manufacturing	65	0	65	65	65	14
32	**Stone, Clay & Glass Products TOTAL**	**215**	**0**	**27[a]**	**46[a]**	**63[a]**	**14**
3312	Steel Works, Blast Furnaces (including Coke Ovens) & Rolling Mills	27	0	27	27	26	3
3331	Primary Copper Smelting & Refining	7	0	7	7	7	6
3339	Primary Smelting and Refining of Nonferrous Metals, n.e.c.	4	1	3	3	3	2
334	Secondary Smelting and Refining of Nonferrous Metals	8	1	7	7	7	7
33	**Primary Metal Industries TOTAL**	**46**	**2**	**0[a]**	**0[a]**	**32[a]**	**17[a]**
347	Coating, Engraving and Allied Services	31	1	30	30	30	30
349	Miscellaneous Fabricated Products	39	0	39	39	39	39

TABLE D-12
SUMMARY OF ESTIMATES OF ADDITIONAL REPORTING FOR MERCURY AND MERCURY COMPOUNDS

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
34	**Fabricated Metal Products TOTAL**	**70**	**1**	**0[a]**	**0[a]**	**49[a]**	**68[a]**
364	Electric Lamp Bulbs and Tubes	78	0	78	78	78	0
367	Electronic Components and Accessories	91	3	88	88	88	88
369	Miscellaneous Electrical Machinery, Equipment, and Supplies	16	1	15	15	0	0
36	**Electric, Electronic Equipment TOTAL**	**185**	**4**	**28[a]**	**132[a]**	**161[a]**	**88[a]**
382	Laboratory Apparatus and Analytical, Optical, Measuring, and Controlling Instruments	33	0	33	33	33	33
3843	Dental Equipment and Supplies	9	2	7	7	7	7
38	**Instruments, Related Products TOTAL**	**42**	**2**	**0[a]**	**0[a]**	**35[a]**	**40[a]**
4911	Electric Services	Coal: 390 Oil: 124	1	Coal: 388 Oil: 32	Coal: 385 Oil: 3	Coal: 328 Oil: 0	Coal: 122 Oil: 0
4931	Electric and Other Services Combined	Coal: 197 Oil: 98	0	Coal: 196 Oil: 25	Coal: 195 Oil: 2	Coal: 166 Oil: 0	Coal: 62 Oil: 0
4939	Combined Utilities, n.e.c.	Coal: 19 Oil: 14	0	Coal: 19 Oil: 4	Coal: 19 Oil: 0	Coal: 16 Oil: 0	Coal: 6 Oil: 0
4953	Commercial Hazardous Waste Treatment	162	0	36	30	16	12

TABLE D-12
SUMMARY OF ESTIMATES OF ADDITIONAL REPORTING FOR MERCURY AND MERCURY COMPOUNDS

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
49	**Electric, Gas, and Sanitary Services TOTAL**	**1,004**	**0 - 162**	**700**	**634**	**526**	**202**
5169	Chemicals and Allied Products Wholesale	7	0	7	7	7	7
5171	Petroleum Bulk Stations & Bulk Terminals	3,842	0	2,227[c]	1,126[c]	412[c]	112[c]
51	**Wholesale Trade, Nondurable Goods TOTAL**	**3,849**	**0**	**2,234**	**1,133**	**419**	**119**
7389	Solvent Recovery Systems	191	0	2	2	0	0
	TOTAL FOR FACILITIES USING CHEMICAL (Excluding SIC Code 20-39 facilities performing combustion operations)	**6,909**	**≥ 33**	**3,448**	**2,729**	**2,216**	**1,452**
20-39	**TOTAL FOR FACILITIES BURNING COAL AND OIL FUELS**	**21,345[b]**		**7,909[b]**	**2,617[b]**	**266[b]**	**20[b]**
	TOTAL FOR ALL FACILITIES	**28,254**	**≥ 33**	**11,357**	**5,346**	**2,482**	**1,472**

Mercury and Mercury Compound Footnotes
est. - estimated value
n.e.c. - not elsewhere classified
[a] Facilities expected to exceed a lower reporting threshold due to an activity, other than combustion, that results in the manufacture, process or otherwise use of mercury or mercury compounds and assumed to exceed a lower reporting threshold due to combustion (and already included in the coal/oil combustion facilities estimate) have been subtracted from the total facilities estimated to report due to non-combustion activities to avoid double counting.
[b] Number of facilities have been adjusted to subtract those with ten or fewer employees and combustion of non-process fuel.
[c] Total number of facilities may differ from those presented in Table D-11 due to rounding of the percent of facilities handling each fuel type.

D.4 CONCLUSIONS

Disregarding the *de minimis* concentration exemption for processed or otherwise used mixtures and trade name products and manufactured product impurities, an additional 1,472 to 11,357 reports may be submitted for mercury and mercury compounds, depending on the reporting threshold. The estimated number of reports at each lower reporting threshold is presented below:

- 1 lb/yr - 11,357 reports
- 10 lbs/yr - 5,346 reports
- 100 lbs/yr - 2,482 reports
- 1,000 lbs/yr - 1,472 reports

LITERATURE CITED

1. Craig, Robert (1993). Restorative Dental Materials, 9th Edition.

2. Dobra, John L. (1997). The U.S. Gold Industry 1996. Nevada Bureau of Mines and Geology.

3. Eastern Research Group (ERG), Inc. (1998). Industrial Combustion Coordinated Rulemaking (ICCR Database).

4. Eastern Research Group (1998). Survey of Facilities Reporting to TRI Under SIC 5169. June 1998.

5. Federal Register Notices (1998). Vol 63, No. 69. FRN 17847-17848. Source Category Listing for Section 112 (d) (2) Rulemaking Pursuant to Section 112 (c) (6) Requirements. EPA FRL - 5994-8; Docket No. A-97-05. April 10.

6. Kroschwitz, I. ed. (1994). Kirk- Othmer's Encyclopedia of Industrial Chemicals, 4th ed. John Wiley and Sons. New York, New York.

7. Hogan, William T., S.J. and Frank T. Koelble (1996). New Steel. Steel's Coke Deficit: 5.6 Million Tons and Growing.

8. National Petroleum Refiners Association (1995). United States Refining Capacity. Washington, DC.

9. Perry, Robert. H. (1984). Perry's Chemical Engineers' Handbook Sixth Edition. McGraw-Hill, Inc. New York, New York.

10. Radian Corporation (1995). Trial Burn Report.

11. United States Steel (1985). The Making, Shaping and Treating of Steel 10th Ed. Association of Iron and Steel Engineers.

12. U.S. Department of Commerce (1992a). 1992 Census of Manufactures: Industry Series. Bureau of the Census.

13. U.S. Department of Commerce (1992b). 1992 Census of Wholesale Trade: Subject Series -Miscellaneous Subjects. Bureau of the Census.

14. U.S. Department of Commerce (1992c). 1992 Census of Mineral Industries: Industry Series. Bureau of the Census.

15. U.S. Department of Commerce (1995). 1995 County Business Patterns. Bureau of the Census. CBP/95-1.

16. U.S. Department of Energy (1995). U.S. Coal Production by State.

17. U.S. Department of Energy (1997). Manufacturing Consumption of Energy 1994. Energy Information Administration. DOE/EIA-0512.

18. U.S. EPA (1987). Standard Industrial Classification Manual. Office of Management and Budget. Springfield, Virginia.

19. U.S. EPA (1995a). 1995 Toxic Release Inventory (TRI) Database. Office of Pollution Prevention and Toxics.

20. U.S. EPA (1995b). Preliminary Study of the Iron and Steel Category. Office of Water. EPA-821-R-95-037. September 1995.

21. U.S. EPA (1995c). Profile of the Metal Mining Industry. Sector Notebook Project. Office of Enforcement and Compliance Assurance.

22. U.S. EPA (1995d). RCRA Biennial Reporting System (BRS) Database. 1995 BRS GM Form Summary for Mercury, CAS 7439976. Office of Solid Waste. 1998.

23. U.S. EPA (1995e). Profile of the Petroleum Refining Industry. Office of Enforcement and Compliance Assurance. EPA 310-R-95-013.

24. U.S. EPA (1997a). 1990 Emissions Inventory of Section 112 (c) 6 Pollutants. Emissions, Monitoring and Analysis Division and Air Quality Strategies and Standards Division. Research Triangle Park, North Carolina. June 1997.

25. U.S. EPA (1997b). Mercury Study Report to Congress Vol. II. Office of Air Quality Planning and Standards; and Office of Research and Development.

26. U.S. EPA (1997c). Locating and Estimating Air Emissions from Sources of Mercury and Mercury Compounds. Data for Portland Cement Manufacturers.

27. U.S. EPA (1997d). Economic Analysis of the Final Rule to Add Certain Industries to EPCRA Section 313. Office of Pollution Prevention and Toxics.

28. U.S. EPA (1997e). Locating and Estimating Air Emissions from Sources of Mercury and Mercury Compounds. Office of Air Quality Planning and Standards.

29. U.S. EPA (1998) 1996 Toxics Release Inventory (TRI) Database, Office of Pollution Prevention and Toxics.

30. U.S. Geological Survey (1995). Mineral Information, Lime.

31. U.S. Geological Survey (1996). Statistical Summary. Minerals Information.

32. U.S. Geological Survey (1998a). Mineral Commodity Summaries.

33. US Geological Survey (1998b). E-mail: Content of mercury in mining ores.

34. van Oss, Hendrik G. (1996). Cement. U.S. Geological Survey — Minerals Information.

PERSONAL COMMUNICATION

1. U.S. EPA (1997f). Memo by Steven Hassur, "The Release of Trace Metals from Limestone During Flue Gas Desulfurization by Electric Utilities."

APPENDIX E
OCTACHLOROSTYRENE

E.1 CHEMICAL PROFILE

Octachlorostyrene (OCS) (CAS 29082-74-4) is a polychlorinated styrene that is a possible byproduct of chlorine production, chlorination reactions, and metal product/finishing operations (EPA, 1998) such as the production of metallic magnesium (Knutzen and Oehme, 1989) and dry etching of aluminum (Raabe et al., 1993). OCS may also be formed by the high-temperature incineration of chlorinated hydrocarbons (EPA, 1998). OCS is not a commercial product, and no commercial uses are known. Industrial processes that may be sources of OCS include the following:

- Radical initiated chloralkene polymerization, a process involving aromatic radicals, vinyl or styrene monomers, and chlorine atom sources;
- Electrolysis of chloride salts in processes using graphite or carbon anodes at temperatures greater than 275°C. This process may be used in the production of chlorine, aluminum, sodium metal, tantalum metal, and niobium metal;
- Manufacture of metallic magnesium using carbon electrodes;
- Fused salt electrolysis, a process used to produce sodium from sodium chloride;
- Aluminum production that utilizes a smelting process created by Alcoa in 1976, that incorporates alumina, carbon, chlorine, and a carbon electrode at high temperatures;
- Incineration of chlorine-containing plastics and organic chemicals (EPA, 1984);
- Degassing of molten aluminum with hexachloroethane (HCE) (Westberg et al., 1997); and
- Production of perchloroethylene and carbon tetrachloride using the Stauffer or Scientific Design processes (Markovee and Magee, 1984).

Historically, OCS byproduct was generated in the manufacture of chlorine from aqueous sodium chloride or potassium chloride by an electrolytic process. The electrolytic process, involving an anode made of powdered graphite with a coal tar pitch binder, leads to the production of a mixture of chlorinated organics that are later removed as a waste byproduct. This waste byproduct, known as “taffy”, may contain OCS. The improper disposal of the taffy may release OCS into the environment (Kiminsky, 1984). Powdered graphite anodes with coal tar pitch binders were used exclusively for chlorine production until 1979; however, the development of noble metal oxide coatings on titanium substrates has led to a drastic reduction in the use of graphite electrodes. Most chlorine producers presently use ruthenium oxide or titanium oxide coated titanium anodes rather than graphite anodes (Kroschwitz, 1994); five manufacturers are expected to still use graphite anodes in their production processes (EPA, 1986, EPA, 1995b). OCS production from operations not employing graphite anodes is considered unlikely due to the lack of a carbon source in these processes.

OCS has been identified as a byproduct from the manufacture of carbon tetrachloride (CTC) and perchloroethylene (PCE). These chemicals are commercially produced using the Stauffer or Scientific Design processes; both processes involve high-temperature chlorinolysis (550 to 600°C) of propylene in an excess of chlorine (Markovee and Magee, 1984). The recovered products of the reaction are CTC, PCE, and chlorine. Chlorinated, high-boiling residues are also produced; these residues form a "hex-waste" byproduct consisting primarily of hexachlorobenzene, hexachlorobutadiene, and hexachloroethene (HCE). Heavier compounds, including OCS, are present at lower concentrations (Markovee and Magee, 1984).

OCS is also a potential byproduct of the production of metallic magnesium. The process involves electrolyzing magnesium chloride to metallic magnesium and chlorine using a carbon electrode. The process leads to the formation of considerable amounts of chlorinated hydrocarbons, including OCS. According to the International Magnesium Association, there are two metallic magnesium plants operating in the United States that use carbon electrodes. The combined capacity of these two facilities is 100,000 metric tons of metallic magnesium per year (IMA, 1998).

OCS byproduct is also produced during degassing of molten aluminum with HCE (Westberg et al., 1997) at aluminum foundries and secondary smelting plants. Hydrogen gas from the surrounding water vapor is readily dissolved in molten aluminum and causes deficient mechanical properties in the resulting aluminum castings. Degassing operations remove the hydrogen gas from the molten aluminum. Gaseous emissions from HCE-based aluminum degassing have demonstrated high yields of complex organochlorine compounds, including HCB and OCS (Westberg et al., 1997).

E.2 CURRENT TOXICS RELEASE INVENTORY (TRI) STATUS

OCS is not currently reportable to TRI.

E.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS TO TRI

This section estimates the number of TRI reports that may be submitted for OCS at various lower reporting thresholds. The reporting thresholds analyzed are 1 pound; 10 pounds; 100 pounds; and 1,000 pounds. The following estimates assume that the *de minimis* exemption would be eliminated; thus, TRI reporting is expected from facilities manufacturing, processing or otherwise using OCS above the reporting thresholds, regardless of the concentration.

E.3.1 ANALYTICAL METHODS

This subsection explains the methods used to estimate the number of additional facilities that may submit TRI reports for OCS at various lower reporting thresholds.

Although potential industrial sources of OCS have been identified, information is limited regarding the amount of OCS manufactured as a byproduct. For the industrial sectors without

OCS data, hexachlorobenzene (HCB) was chosen as a surrogate to estimate the amount of OCS manufactured as well as the number of potential TRI reports. HCB and OCS are structurally similar chemicals; both are a benzene ring surrounded by chlorine atoms. The difference between the two molecules is the substitution of a styrene molecule (carbon and hydrogen) for a chlorine atom at one of the benzene ring carbons. Based on the available information and the structural similarity of OCS and HCB, these chemicals appear to be manufactured as byproducts in many of the same processes. It is unknown whether OCS is also present as an impurity in products containing HCB as an impurity (e.g. chlorinated solvents). For this analysis, it is assumed that OCS does not remain with the manufactured product, but is removed with the process wastes. To avoid double counting, the total amount of OCS estimated for each SIC Code does not include the amount of OCS received by treatment, storage, and disposal facilities (TSDFs).

Chemicals and Allied Products (SIC Code 28)

OCS may be formed as a byproduct/impurity during several processes in SIC 28, including:

- during electrolysis of chloride salts such as sodium chloride and magnesium chloride using carbon anodes in SIC 2812 (EPA, 1998).
- during chlorination of various organic compounds in SIC 2865 (EPA, 1998).
- during pesticide manufacturing in SIC 2879.

To estimate the number of facilities which may report OCS to TRI for various 4-digit SIC codes in the Chemicals and Allied Products Category, information on the amount of HCB and OCS produced in comparison to product yield for the manufacture of CTC and PCE by the Stauffer or Scientific Design processes (Markovee and Magee, 1984) was used. The ratio of OCS to HCB byproduct manufactured in SIC Code 2869 was then applied to the minimum quantities of HCB inferred from the TRI information (EPA, 1995b) to estimate the amount of OCS produced per facility in other 4-digit SIC codes.

The manufacture of CTC and PCE by the Stauffer or Scientific Design processes involves the chlorination of propylene, followed by distillation to separate and recover CTC and PCE. Under optimum conditions, 96 percent of the propylene is converted to CTC and PCE. The remaining 4 percent of propylene is converted to a byproduct residue termed “hex-waste”, of which HCB is a major component (assumed to be 75%). The other byproducts compose the remaining 25% of hex-waste, 22% of which is OCS (Markovee and Magee, 1984). Using the stoichiometric relationship between CTC and PCE manufacture from propylene and the waste generation and composition from the literature, approximately 0.0048 pounds of OCS byproduct is manufactured per pound of PCE manufactured. The calculated OCS:HCB production ratio is 0.073 lbs OCS/lb HCB from the CTC and PCE manufacturing process. The estimated concentration of OCS in the total amount of hex waste generated from the process is 5.5 percent.

From this information, the estimated amount of OCS from each facility in SIC code 2869 can be determined. Three facilities in SIC Code 2869 supplied enough PCE to meet a demand for 290 million pounds in 1997 (Chemical Marketing Report, 1997). Each facility therefore produces approximately 464,000 lb OCS as a byproduct per year, as shown below.

(290 million lb PCE/yr) x (0.0048 lb OCS / lb PCE) / (3 facilities) = 464,000 lb OCS/facility/yr

To determine which additional 4-digit SIC Codes in the Chemical and Allied Products category may manufacture OCS as a byproduct/impurity, and to estimate the amount per facility, the 1995 TRI reports for HCB were analyzed. According to the 1995 data, facilities in SIC codes 2812, 2865, and 2879 submitted TRI reports for the manufacture of HCB (EPA, 1995b). Using the TRI data, HCB production was estimated to be 25,000 lb per facility reporting in 1995 or the combined releases and off-site transfers of HCB, whichever amount was greater. Table E-1 presents a summary of estimated amount of HCB manufactured and the calculated OCS production amounts based on the CTC and PCE data for the three SIC codes.

TABLE E-1
ESTIMATED OCS MANUFACTURE
BASED ON HEXACHLOROBENZENE MANUFACTURE/RELEASES

SIC Code	Number of Reports	Estimated Amount of HCB Manufactured (lb/year) (EPA, 1995b)	OCS:HCB ratio	Estimated Amount of OCS Manufactured (lb/year)
2812	4	100,000	0.073	7,300
2865	1	25,000	0.073	1,800
2879	3	470,468	0.073	34,300

The number of facilities that may submit TRI reports for OCS at various thresholds for SIC Code 2812 (alkalis and chlorine) were estimated from the Final Draft Report - Exposure Assessment for HCB (EPA, 1986). According to the report, only five chlorine manufacturing facilities in the United States had not converted from graphite (carbon) electrodes to metal electrodes by 1984. The 1995 TRI information shows that 4 chlorine manufacturing facilities had reported HCB manufacturing. This data indicates that at least 4, and possibly 5 chlorine manufacturing facilities are still using carbon electrodes and may submit TRI reports for OCS. During the comment period for the final rule, one commenter questioned whether any facilities were still using graphite electrodes. The 1997 TRI data, however, shows 5 facilities in SIC 2812 reported HCB manufacturing. Therefore, the 5 facility estimate was not changed. The amount of OCS per facility in SIC Code 2812 was calculated as:

(7,300 lb/yr) / 5 facilities = 1,460 lb/facility/yr

The number of facilities that may submit TRI reports for OCS at various thresholds for SIC codes 2865 and 2879 was estimated using the following method:

- Using the *Standard Industrial Classification Manual* (Executive Office of the President, 1987), those 5-digit SIC codes most likely to manufacture OCS as a byproduct were identified. Those SIC codes were 28651, 28652, 28653, 28655, 28656, 28795, 28796, 28797, 28798, and 28799.
- At the 4-digit SIC code level, the percentage of facilities in each identified SIC code having 10 or more full-time employees was obtained from the *1995 County Business Patterns* (Department of Commerce, 1995); and

- The number of facilities from the *1992 Census of Manufactures, Industry Series* (Department of Commerce, 1992) in each of the identified 5-digit SIC codes was multiplied by the calculated percentage of facilities in the corresponding 4-digit SIC code having 10 or more full-time employees.

The data for the steps outlined above are presented in Table E-2. By dividing the number of facilities shown in Table E-2 into the amount of OCS manufactured per year (Table E-1), the amount of OCS manufactured per year, and therefore the TRI reporting threshold can be determined. Because it is assumed that every facility in the 5-digit SIC code with 10 or more employees is manufacturing OCS as a byproduct, this estimation method results in a high-end estimate of the number of reports at various thresholds. The low end of the range is the number of facilities in the 1995 TRI database (EPA, 1995b) that claim the 4-digit SIC code as their primary manufacturing description and that manufacture hexachlorobenzene as a byproduct or impurity.

TABLE E-2
ESTIMATED NUMBER OF FACILITIES POTENTIALLY PRODUCING OCS FROM SELECTED MANUFACTURING SECTORS

Industry Description	Total Facilities in 5-Digit Code[b]	Total Facilities in 4-Digit Code[c]	Facilities with ≥10 Employees in 4-Digit Code[c]	% of Total Facilities with ≥10 Employees in 4-Digit Code	Estimated Facilities with ≥10 Employees in 5-Digit Code	OCS per Facility (lb/yr)
Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments (SIC Code 2865)	149	209	165	79	1 - 118	15 - 1,800
Pesticides and Agricultural Chemicals (SIC Code 2879)	127	242	144	60	3 - 76	>30,000 (1 facility) [d]; <1,000 (2 - 75 facilities)

n.e.c. - not elsewhere classified
NA - Information was not available
Sources:
[a] Executive Office of the President, 1987
[b] Department of Commerce, 1992.
[c] Department of Commerce, 1995.
[d] One facility reported 420,468 lb of HCB releases and off-site transfers for 1995 (EPA, 1995b). This facility is estimated to manufacture approximately 30,694 lb OCS as a byproduct.

Magnesium Production (SIC Code 3339)

OCS has been identified as a potential byproduct of metallic magnesium production from magnesium chloride using carbon electrodes. According to the literature, annual OCS byproduct manufacture was estimated between 130 and 180 pounds from one facility located in Norway (Knutzen and Oehme, 1989). The actual concentration of OCS in the process wastes is

unknown. Assuming that the magnesium plant in Norway was similar in size to the two U.S. metallic magnesium producers, then between 260 and 360 pounds per year of OCS byproduct is expected from this process. Therefore, the two U.S. metallic magnesium producers may report to TRI at thresholds of 1 pound, 10 pounds, and 100 pounds.

Aluminum Production (SIC Codes 3341 and 3365)

OCS is manufactured as a byproduct in the aluminum production industry when HCE is used to remove hydrogen gas from molten aluminum (Westberg et al., 1997). Quantitative information on the amount of OCS produced in comparison to the amount of HCE used was available from the literature (Westberg et al., 1997). This information was used to estimate the amount of OCS generated by the degassing process. According to The Aluminum Association (1998), five secondary aluminum smelting operations in the U.S. use HCE for degassing; this information was used to estimate the number of primary aluminum foundries that may use HCE for degassing.

According to the literature, a remelt furnace was charged with 70 kg of an aluminum alloy and degassed using two 50 g tablets containing 85% HCE (Westberg et al., 1997). This results in a ratio of 0.00121 lb HCE/lb aluminum alloy, as shown below.

$$(2 \times 50 \text{ g HCE} \times 85\%) / 70{,}000 \text{ g alloy} = 0.00121 \text{ g HCE / g alloy} = 0.00121 \text{ lb HCE / lb alloy}$$

Analysis of the emissions from the process detected 0.78 mg OCS per gram of HCE (Westberg et al., 1997). Using this information, an OCS:aluminum alloy ratio of 9.44×10^{-7} was calculated and is shown below.

$$(7.8 \times 10^{-4} \text{ g OCS / g HCE}) \times (0.00121 \text{ g HCE / g alloy}) = 9.44 \times 10^{-7} \text{ lbs OCS/lb Al alloy}$$

To estimate the number of aluminum foundries using HCE in degassing, the percentage of secondary smelting plants using HCE in degassing was applied to the number of aluminum foundries. These data are presented in Table E-3.

TABLE E-3
ESTIMATED NUMBER OF ALUMINUM FOUNDRIES
USING HCE DEGASSING OPERATIONS

SIC Code	Total Foundries[a]	Total Secondary Smelting Facilities[a]	Secondary Smelting Facilities Using HCE[b]	% of Total Secondary Smelting Facilities Using HCE	Estimated Foundries Using HCE
3365	591	72	5	7	41

Sources:
[a]Department of Commerce, 1992
[b]EPA, 1993

The amount of aluminum produced by secondary smelting facilities using HCE was available from The Aluminum Association (1998); however, only the total primary aluminum

production was available from the listed references. Assuming that the foundries produce approximately equal amounts of aluminum each year, a scaling factor of 7% (calculated above) was applied to estimate the amount of primary aluminum production using HCE degassing operations. Table E-4 presents the estimated amount of OCS manufactured by the primary and secondary aluminum industry.

TABLE E-4
ESTIMATED ALUMINUM INDUSTRY OCS MANUFACTURE

SIC Code	Estimated Amount of Aluminum Manufactured (million lb/year)	OCS:Aluminum ratio	Total Estimated Amount of OCS Manufactured (lb/year)	OCS per Facility (lb/yr)
3341	108[a]	9.44×10^{-7}	102	20
3365	556[b]	9.44×10^{-7}	525	13

Sources:
[a]Aluminum Association, 1998 (converted from 53,922 tons)
[b]3,600,000 metric tons Al (USGS, 1998) x (2,205 lb / metric ton) x 7% using HCE = 556,000,000 lb Al using HCE

Commercial Hazardous Waste Treatment (SIC Code 4953)

OCS may be generated at incineration facilities during the thermal decomposition of plastic wastes. The OCS is considered "otherwise used." As indicated in the economic analysis of EPA's recent TRI industry expansion (EPA, 1997) 53 hazardous waste incinerators are now subject to the TRI reporting requirements. There are no data available on typical concentrations expected for OCS. All 53 incinerators are assumed to generate OCS in quantities exceeding the four regulatory options, but below current reporting thresholds.

Other Industry Sectors

The dry etching of aluminum conductors with CTC or boron trichloride for microelectronic components (SIC code 3471) has been demonstrated to produce OCS byproduct (Raabe et al., 1993). Samples collected from a reactor contaminated with waste products from etching operations were composed of 0.6% OCS (Raabe et al., 1993). Quantitative information is not currently available to estimate the total amount of OCS produced by aluminum etching or the number of facilities producing OCS by this process.

There may be a potential for incidental manufacturing of OCS at pulp mills (EPA, 1998); however, the pulp and paper industry has been drastically reducing its use of chlorine bleaches. Therefore, no pulp mills (SIC code 2611) were included in estimates of OCS reports.

Medical waste incinerators are not currently required to submit reports to TRI; however, they are considered to be potential producers of OCS through incineration of polyvinyl chloride (PVC) plastics.

There is a potential for OCS formation at cement kilns incinerating hazardous wastes. Based on professional knowledge of the industry, however, cement kilns are not expected to submit reports to TRI for OCS.

Production of coke, pentachlorophenol, vinyl chloride, polyvinyl chloride, and rubber tires are suspected of forming OCS (Batelle, 1998), however, quantitative information on OCS formation from these processes is not available. Therefore, these facilities were not included in the estimates of OCS reports to TRI.

Summary

Industries manufacturing OCS that may submit TRI reports at the lowered thresholds are presented in Table E-5, along with the results of the analysis.

TABLE E-5
ESTIMATES OF ADDITIONAL TRI REPORTING FOR OCTACHLOROSTYRENE (OCS)

SIC Code	Industry Sector	Total Number of Facilities with 10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
2812	Alkalies and Chlorine	5 (EPA, 1986)	NA	5	5	5	5
2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments	1 - 118 (EPA, 1995b) (Dept. of Commerce, 1992, 1995)	NA	118	118	1 - 118	1
2869	Industrial Organic Chemicals, n.e.c.	3 (Exec Office, 1987)	NA	3	3	3	3
2879	Pesticides and Agri-cultural Chemicals, n.e.c.	3 - 76 (EPA, 1995b) (Dept. of Commerce, 1992, 1995)	NA	76	3 - 76	3	3
28	**Chemicals and Allied Products TOTAL**	**12 - 202**	**NA**	**202**	**129 - 202**	**12 - 129**	**12**
3339	Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminum	2 (Aluminum Association, 1998)	NA	2	2	2	0
3341	Secondary Smelting and Refining of Nonferrous Metals	5 (International Mg Association, 1998)	NA	5	5	0	0
3365	Aluminum Foundries	41 (Dept. of Commerce, 1992)	NA	41	41	0	0
33	**Primary Metal Industries TOTAL**	**48**	**NA**	**48**	**48**	**2**	**0**
4953	Commercial Hazardous Waste Treatment	162 (EPA, 1997)	NA	53	53	53	53
	TOTAL FOR ALL FACILITIES	**222 - 412**	**NA**	**303**	**230-303**	**67-184**	**65**

E.4 CONCLUSIONS

As a result of lowering the TRI reporting thresholds and adding OCS to the TRI, the estimated total number of reports for OCS at the various lower thresholds are summarized below. It should be noted that there is considerable uncertainty regarding potential sources and amounts of OCS.

- 1 lb/yr - 303;
- 10 lb/yr - 230 to 303;
- 100 lb/yr - 67 to 184; and
- 1,000 lb/yr - 65.

LITERATURE CITED

1. Batelle Memorial Institute (1998). Great Lakes Binational Toxics Strategy Octachlorostyrene Report.

2. Canada-Ontario Agreement (1994). First Progress Report Under the 1994 Canada-Ontario Agreement.

3. Chemical Marketing Reporter (1997). Chemical Profile - Perchloroethylene, December 15.

4. Executive Office of the President (1987). Standard Industrial Classification Manual (1987). Office of Management and Budget.

5. Hazardous Substances Data Bank (HSDB) (1997).

6. Kiminsky, R., and R. Hites (1984). Octachlorostyrene in Lake Ontario: Sources and Fates. Environmental Science Technology. Vol. 18, No. 4.

7. Knutzen, J. and M. Oehme (1989). "Polychlorinated Dibenzofuran (PCDF) and Dibenzo-p-dioxin (PCDD) Levels in Organisms and Sediments from the Frierfjord, Southern Norway." Chemosphere, Volume 18, Number 12.

8. Kroschwitz, I. ed. (1994). Kirk-Othmer's Encyclopedia of Industrial Chemicals, 4th ed. John Wiley and Sons. New York.

9. Markovee, L. and R. Magee (1984). "Identification of Major Perchloroaromatic Compounds in Waste Products from the Production of Carbon Tetrachloride and Tetrachloroethylene (1984)." Analyst, Vol. 109: 497-501. April.

10. Ofstad, E., G. Lunde, and K. Martinsen (1978). "Chlorinated Aromatic Hydrocarbons in Fish from an Area Polluted by Industrial Effluents." The Science of the Total Environment 10: 219-230.

11. Raabe, F. et al. (1993). "Genotoxicity Assessment of Waste Products of Aluminum Plasma Etching with the SOS Chromotest." Mutation Research 300: 99-109.

12. U.S. Department of Commerce (1995). County Business Patterns. Economics and Statistics Administration, Bureau of the Census.

13. U.S. Department of Commerce (1992). 1992 Census of Manufactures, Industry Series. Bureau of the Census.

14. U.S. EPA. AP-42, Compilation of Air Pollution Emission Factors. Office of Air. Various years.

15. U.S. EPA (1997). Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313. Office of Pollution Prevention and Toxics. April.

16. U.S. EPA (1995a). 40 CFR 261. U.S. Government Printing Office. June.

17. U.S. EPA (1998). Great Lakes Binational Toxics Strategy Implementation Meeting. March 23, Octachlorostyrene Meeting Minutes.

18. U.S. EPA (1995b). Toxics Release Inventory (TRI) Database.

19. U.S. EPA (1993). Secondary Aluminum Production Maximum Achievable Control Technology (MACT) Information Collection Request (ICR). 1992/1993.

20. U.S. EPA (1984). Sources of Polychlorinated Styrenes in the Great Lakes and their Tributaries. U.S. EPA Grant No. R00-5764-01.

21. U.S. EPA (1986). Final Draft Report - Exposure Assessment for HCB. EPA Contract No. 68-02-3968, Task 127. May 14.

22. U.S. Geological Survey (1998). Mineral Commodity Summaries: Aluminum. January.

23. U.S. International Trade Commission (1989). Synthetic Organic Chemicals - U.S. Production and Sales, 1988. USITC Publication. Washington, DC, U.S. International Trade Commission.

24. Westberg, H. et al. (1997). Emissions of Some Organochlorine Compounds in Experimental Aluminum Degassing with Hexachloroethane. Applied Occupational and Environmental Hygiene 12(3): 178-183. March.

PERSONAL COMMUNICATIONS

1. Aluminum Association, The (1998). Memorandum to Robert Bailey (Bailey Associates) regarding a review of the draft report "Global Hexachlorobenzene Emissions". April 29.

2. International Magnesium Association, McLean, Virginia (1998). Telephone call regarding the electrolytic production of metallic magnesium using carbon electrodes. August 19.

APPENDIX F
PENTACHLOROBENZENE

F.1 CHEMICAL PROFILE

Pentachlorobenzene (CAS 608-93-5) is formed by the chlorination of a benzene ring. Pentachlorobenzene is not used as an end product; instead, it is used exclusively as a intermediate in the production of the fungicide pentachloronitrobenzene (quintozene). Quintozene has been commercially produced since the 1930s and is also referred to as PCNB and PkhNB. It has also been marketed under the following trade names: Avicol, Earthcide, Folosan, Kobu, Kobutol, Pentagen, RTU, PCNB, Terrachlor, Terrazan and Tri-PCNB (Sine, 1994).

Pentachlorobenzene is found in the quintozene process waste stream as an unreacted intermediate and in the final product as an impurity. Pentachlorobenzene is released to the environment as an impurity during the application of quintozene and as a waste byproduct in the unreacted process residue. The end-product quintozene is used as a fungicide for seed treatment, soil application, and as a slime inhibitor in industrial waters. The distribution of quintozene use in agricultural and residential applications is as follows: peanuts 47%; lawns and turf 16%; field crop seeds 11%; potatoes 3%; vegetables 3%; and other field crops (e.g. soybeans and cotton) 21% (Spectrum, Undated c).

Pentachlorobenzene may also be produced whenever organic compounds are burned in the presence of a chlorine source. Pentachlorobenzene may be produced in small quantities in combustion processes such as those used in medical waste incinerators, cement kilns, municipal waste and sewage sludge incinerators, and secondary copper production.

F.2 CURRENT TOXIC RELEASE INVENTORY (TRI) STATUS

Although pentachlorobenzene is not currently reported to TRI, quintozene is reported. In 1995, five pesticide manufacturers filed Form Rs reporting a total of 2,251 pounds of releases of quintozene. An additional four pesticide facilities filed Form A for quintozene, and one fertilizer mixing facility filed a Form R. If pentachlorobenzene were presently reportable to TRI and the reporting thresholds were lowered, it is likely that all of these facilities would submit TRI reports for pentachlorobenzene. Table F-1 summarizes the TRI reporting of quintozene in 1995.

TABLE F-1
SUMMARY OF TRI REPORTING FOR QUINTOZENE, 1995

SIC Code	Number of Form Rs	Number of Form As
Fertilizers, Mixing (SIC Code 2875)	1	0
Pesticides (SIC Code 2879)	5	4

Source:(EPA, 1997b.)

F.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS

This section presents estimates of additional TRI reporting for pentachlorobenzene, assuming the reporting thresholds are lowered. Four reporting threshold levels were analyzed: 1 pound; 10 pounds; 100 pounds; and 1,000 pounds. The following estimates also assume that the *de minimis* exemption would be eliminated; thus TRI reporting is expected from facilities manufacturing, processing, or otherwise using pentachlorobenzene above the reporting thresholds, regardless of the concentration.

For the estimates presented below of the total amount of pentachlorobenzene manufactured, processed, or otherwise used, information from the 1995 TRI database, including the number of facilities reporting, the reporting threshold, and the reported current releases. The TRI database information is used in conjunction with the pentachlorobenzene fractions listed in Table F-2. The total facility usage of each reported chemical is assumed to be greater than the reporting threshold or amount of chemical released, whichever is larger. Facility usage is then multiplied by the fraction of the chemical that is believed to be pentachlorobenzene.

F.3.1 ANALYTICAL METHODS

Information on pentachlorobenzene is limited. However, pentachlorobenzene is structurally similar to hexachlorobenzene, is generated by chemical reactions similar to those that generate hexachlorobenzene, and is expected to be produced as a byproduct in chemical reactions that produce hexachlorobenzene as a byproduct. Therefore, the estimates of additional TRI reporting for pentachlorobenzene are based primarily on information available for hexachlorobenzene. These estimates are based on the assumption that all chemicals that contain hexachlorobenzene as an impurity also contain pentachlorobenzene as an impurity in the same concentrations. In addition, the pentachlorobenzene profile is based on the assumption that facilities reporting manufacture or production of hexachlorobenzene in the 1995 TRI database also manufacture or produce at least 25,000 pounds of pentachlorobenzene as an impurity in the hexachlorobenzene that they manufacture or produce. An analysis of hexachlorobenzene is presented in Appendix C. A discussion of how the additional TRI reporting was estimated is provided below.

This section describes the process used to estimate the number of additional reports at lower thresholds. The initial analysis began by identifying industries using certain chemicals in which hexachlorobenzene is known or expected to be an impurity using the 1995 TRI database (EPA, 1997b). Table F-2 lists the chemicals that are known or suspected to contain hexachlorobenzene and therefore pentachlorobenzene and their estimated pentachlorobenzene fractions.

The fraction of pentachlorobenzene in chemicals known or expected to contain pentachlorobenzene varies. Table F-2 lists estimates of the fraction of pentachlorobenzene in various chemicals. For pentachlorobenzene in hexachlorobenzene, the fraction is unknown, because information on the fraction of impurities in hexachlorobenzene is not currently available.

The fractions of pentachlorobenzene vary for pesticides and other organic chemicals, but are expected to be low, so a general designation of <1% is used.

Where pentachlorobenzene fractions in a particular chemical are unknown, the average pentachlorobenzene fraction for all chemicals (0.0002), with the exception of pentachlorobenzene, is used. The calculation of the average pentachlorobenzene fraction is presented below:

[DCPA (0.001) + chlorothalonil (0.00005) + picloram (0.00005) + atrazine (0.000001) + simazine (0.000001) + lindane (0.0001) + PCNB (0.0017)+ pentachlorophenol (0.00015)]/8 = 0.0002

Using the available information (EPA, 1993) and the data in Table F-2, the manufacturing facilities in SIC Codes 20 through 39 that potentially manufacture, process or otherwise use pentachlorobenzene were identified. To summarize the data into a useable format, the facilities in SIC Codes 20 through 39 were categorized into two groups; 1) those manufacturing chemicals in which pentachlorobenzene is a byproduct or impurity; and 2) those using chemicals in which pentachlorobenzene is a byproduct or impurity. In each group, the total facility usage of each reported chemical is assumed to be greater than the reporting threshold or amount of chemical released, whichever is larger. For those industries where specific operations either manufacture, process or otherwise use pentachlorobenzene, a detailed analysis by SIC code is provided in the subsequent sections.

TABLE F-2
CHEMICALS SUSPECTED TO CONTAIN PENTACHLOROBENZENE

Chemical Name	CAS No.	Fraction Pentachlorobenzene
Allyl chloride	107-05-1	0.0002[a]
Ametryn	834-12-8	0.0002[a]
Atrazine	118-74-1	0.000001[b]
Benzyl chloride	100-44-7	0.0002[a]
Carbon tetrachloride	56-23-5	0.0002[a]
Chlorine	7782-50-5	0.0002[a]
Chlorobenzene	108-90-7	0.0002[a]
1-Chloropropane	540-54-5	0.0002[a]
Chlorothalonil	1897-45-6	0.00005[b]
Cyanazine	21725-46-2	0.0002[a]
Cyanuric chloride	108-77-0	0.0002[a]
DCPA (dacthal)	1861-32-1	0.001[b]
1,2-Dichlorobenzene	95-50-1	0.0002[a]
1,2-Dichloroethylene	79-01-6	0.0002[a]
2,4-Dichlorophenol	120-83-2	0.0002[a]
Dienochlor	2227-17-0	0.0002[a]
1,3-Dichlorobenzene	541-73-1	0.0002[a]
1,4-Dichlorobenzene	106-46-7	0.0002[a]
1,2-Dichloroethane	107-06-2	0.0002[a]
1,3-Dichloropropene	542-75-6	0.0002[a]
Dipropetryn	4147-51-7	0.0002[a]
Ethyl chloride	75-00-3	0.0002[a]
Freon 113	76-13-1	0.0002[a]
Hexachlorobenzene	118-74-1	unknown
Hexachlorocyclopentadiene	77-47-4	0.0002[a]
Hexafluorobenzene	392-56-3	0.0002[a]
Lindane	58-89-9	0.0001[b]
Maleic hydrazide	123-33-1	0.0002[a]
Mirex	2385-85-5	0.0002[a]
Pentachlorobenzene	608-93-5	0.0002[a]
Pentachloronitrobenzene	82-68-8	0.0017[b]

TABLE F-2
CHEMICALS SUSPECTED TO CONTAIN PENTACHLOROBENZENE

Chemical Name	CAS No.	Fraction Pentachlorobenzene
Pentachlorophenol	87-86-5	0.00015[c]
Phosgene	75-44-5	0.0002[a]
Phthalic Anhydride	85-44-9	0.0002[a]
Picloram	1918-02-1	0.00005[b]
Polyvinyl chloride	75-34-1	0.0002[a]
Prometon	1610-18-0	0.0002[a]
Prometryn	7287-19-6	0.0002[a]
Propazine	139-40-2	0.0002[a]
Simazine	122-34-9	0.000001[b]
Terbutryn	886-50-0	0.0002[a]
Tetrachloroethylene	127-18-4	0.0002[a]
Tetrachlorophthalic anhydride	117-08-8	0.0002[a]
Toluene diisocyanate	584-84-9	0.0002[a]
Trichloroethylene	79-01-6	0.0002[a]
1,1,1-Trichloroethylene	71-55-6	0.0002[a]
1,2,4-Trichlorobenzene	120-82-1	0.0002[a]

[a] Fraction is average of known fractions.
[b] Source: (EPA, 1997d)
[c] Source: (EPA, 1986)
Additional Sources for identifying chemicals known or suspected to contain pentachlorobenzene: (Spectrum Laboratories, undated), (EPA 1997c), (British Horological, undated), (PEI, 1985), (ATSDR, 1990), (NJDH, 1988), (EPA, 1986),(EPA, 1993)

Commercial Hazardous Waste Treatment (SIC Code 4953)

As mentioned above, pentachlorobenzene is structurally similar to hexachlorobenzene, is generated by chemical reactions similar to those that generate hexachlorobenzene, and is expected to be produced as a byproduct in chemical reactions that produce hexachlorobenzene as a byproduct. Therefore, the estimates of additional TRI reporting for pentachlorobenzene are based primarily on information available for hexachlorobenzene. Specifically, the number of pentachlorobenzene reports is assumed to equal the number of hexachlorobenzene reports at each threshold. In this industry, these chemicals are treated for destruction, disposed of, or stabilized under the revised definition of otherwise use, or are manufactured during hazardous waste incineration. The following approach was used to estimate the number of reports expected for hexachlorobenzene under each of the regulatory options.

To estimate the number of commercial hazardous waste treatment facilities that may report on hexachlorobenzene at lower reporting thresholds, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose.

First, TRI data may underestimate the *number of reporting facilities* because TRI- subject hazardous waste facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the hazardous waste facility may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities, and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of hazardous waste treatment facilities at which amounts of hexachlorobenzene would exceed a lower reporting threshold (1, 10, 100, 1,000 lbs) were counted. Facilities exceeding current reporting thresholds were not included in this count.

Chemicals and Allied Products - Wholesale (SIC Code 5169)

Facilities in SIC code 5169 have not yet submitted reports to EPA for TRI. Results of a telephone survey of 9 facilities indicated that none of the facilities with 10 or more employees in SIC code 5169 handled chemicals containing pentachlorobenzene. For this analysis, 1% or 7 of the 717 facilities that are expected to report under the existing thresholds was assumed to be the number of facilities in SIC code 5169 that currently distribute pentachlorobenzene. In this industry, pentachlorobenzene is processed as a component of chlorinated solvents.

Information is not currently available on the amount of pentachlorobenzene processed or otherwise used at facilities in SIC code 5169, therefore the amount per facility is listed as unknown, and the number of additional TRI reports is listed as 0 - 7 for all thresholds except 1 pound. The number of additional TRI reports for pentachlorobenzene at the 1-pound threshold is listed as 3 - 7 because 3 facilities in SIC code 5169 did submit TRI reports for chemicals listed in Table F-2 in 1995. Because facilities in SIC code 5169 are not currently required to conduct TRI reporting, it is believed that these 3 facilities submitted TRI reports voluntarily.

Solvent Recovery Services (SIC Code 7389)

To estimate the number of solvent recovery facilities in SIC 7389 that may report to TRI for pentachlorobenzene under the final rule, data on the prevalence of chemicals potentially contaminated with pentachlorobenzene at these facilities were examined. In this industry, pentachlorobenzene is processed as a component of chlorinated hydrocarbons for solvent recovery or as a component of chlorinated solvents otherwise used.

As part of the data collection for the economic analysis of TRI industry expansion, several solvent recovery facilities in SIC 7389 were contacted to determine which TRI chemicals they handled in amounts exceeding 25,000 pounds. Some of the chemicals that these facilities reported handling may contain pentachlorobenzene in trace amounts (see table below).

Of the 11 facilities for which data were available, 10 reported handling more than 25,000 pounds of at least one chemical associated with possible pentachlorobenzene contamination. Assuming each of the 10 facilities handled at least 50,000 pounds of contaminated chemical at 0.02 percent pentachlorobenzene, these facilities would be expected to report at a 1 pound or 10 pound reporting threshold based on the following calculation:

50,000 lb solvent x (0.0002 lb pentachlorobenzene/ lb solvent) = 10 lb pentachlorobenzene.

The highest number of potentially contaminated chemicals reported at any one facility was five. Assuming this facility handled 50,000 pounds of each of the solvents at 0.02 percent pentachlorobenzene, this facility would be expected to report at a 1 pound or 10 pound threshold, but not at a 100 pound or 1,000 pound threshold based on the following calculation:

5 solvents x 50,000 lb solvent (0.0002 lb pentachlorobenzene/ lb solvent) = 50 lb pentachlorobenzene.

To extrapolate the results from the surveyed facilities to potential reporters in SIC 7389, the percentage of facilities reporting at least one contaminated chemical (10/11 = 91%) was applied to a total of 52 active solvent recovery facilities as identified in *EI Digest*. This results in an estimate of 47 facilities expected to report at the 1 and 10 pound thresholds.

TABLE F-3
CHEMICALS REPORTED ABOVE 25,000 POUNDS IN PHONE SURVEY OF SOLVENT RECYCLERS FROM TRI INDUSTRY EXPANSION

CAS	Chemical Name	Number of Facilities
71-55-6	1,1,1-Trichloroethane	4
76-13-1	Freon 113	2
79-01-6	Trichloroethene	4
95-50-1	1,2-Dichlorobenzene	1
108-90-7	Chlorobenzene	1
127-18-4	Tetrachloroethene	9
25321-22-6	Dichlorobenzene	1

Manufacturing of Pentachlorobenzene (SIC Codes 2865, 2869, 2879 and 2812)

The manufacture of chlorinated organic chemicals and pesticides may result in the generation of pentachlorobenzene as a byproduct or impurity. This analysis assumes that greater than 1,000 pounds of pentachlorobenzene is manufactured at all facilities reporting to TRI the manufacture of hexachlorobenzene in 1995.

For the 1995 reporting year, 9 facilities in SIC codes 2812, 2869, and 2879 reported to TRI the manufacture of hexachlorobenzene in quantities greater than the reporting threshold of 25,000 pounds. These 9 facilities are all of the facilities in SIC codes 20 through 39 reporting the manufacture of hexachlorobenzene.

All of these facilities manufacture hexachlorobenzene in quantities greater than 25,000 pounds. Although these facilities are currently reporting the manufacture of hexachlorobenzene to TRI, the manufacture of any accompanying pentachlorobenzene is not currently reported. The concentration of pentachlorobenzene is unknown; therefore, this analysis assumes that any facilities in these SIC codes generating greater than 25,000 pounds of hexachlorobenzene per year also generate pentachlorobenzene in quantities greater than the 1,000 pound threshold.

Additional facilities in SIC codes 2865, 2869, and 2879 and 2812 may manufacture, process, or otherwise use pentachlorobenzene in the manufacture, processing, or otherwise use of chemicals that contain pentachlorobenzene as a byproduct or impurity. These facilities are included in the analysis below that groups facilities in SIC codes 20-39.

Manufacturing Chemicals In Which Pentachlorobenzene Is A Byproduct Or Impurity (SIC Codes 20 Through 39)

Pentachlorobenzene may be manufactured as a byproduct or impurity during the manufacture of chlorinated organic compounds. To estimate the total amount of pentachlorobenzene manufactured, information from the 1995 TRI database, including the number of facilities reporting, the reporting threshold (25,000 pounds for manufacturing), and the reported current releases, was used. This information was used in conjunction with the pentachlorobenzene fractions listed in Table F-2. Total facility manufacture of each reported chemical is assumed to be greater than the reporting threshold of 25,000 pounds or the amount of chemical sent off site, whichever is larger. The amount manufactured is then multiplied by the fraction of the chemical that is believed to be pentachlorobenzene.

For example, one facility from SIC Code 2879 (pesticides), submitted a TRI report for the manufacture of ametryn in 1995. The facility also reported off-site transfers of 17 pounds of

ametryn. Since the reporting threshold of 25,000 pounds is greater than the total off-site transfers, the amount of pentachlorobenzene manufactured by the facility is calculated using the estimated fraction of pentachlorobenzene in ametryn from Table F-2 as follows:

$$>25{,}000 \text{ lb ametryn} \times 0.0002 \text{ lb pentachlorobenzene/lb ametryn}$$

$$= >5 \text{ lb pentachlorobenzene}$$

This amount is then summed over all chemicals at all facilities reporting to TRI in 1995 the manufacture of chemicals containing pentachlorobenzene as a byproduct or impurity. Using this method, the total amount of pentachlorobenzene present as a byproduct or impurity was estimated to be greater than 3,600 pounds/year.

An estimated 131 facilities reported the manufacture of chemicals containing pentachlorobenzene as a byproduct or impurity in 1995 to TRI (EPA, 1997b). Because the typical pentachlorobenzene fraction is 0.0002, which yields 5 pounds when multiplied by the reporting threshold for manufacturing, 25,000 pounds, all facilities that submitted TRI reports in 1995 for the manufacture of chemicals that contain pentachlorobenzene as a byproduct or impurity are anticipated to report at the threshold of 1 lb/year. Facilities that did not submit TRI reports for any of the chemicals known or suspected to contain pentachlorobenzene are assumed to manufacture less than 1 pound of pentachlorobenzene.

Although the fraction of pentachlorobenzene in some chemicals multiplied by the minimum reportable quantity results in estimates slightly less than 1 pound, it is assumed that the total quantity of pentachlorobenzene at these facilities would also be 1 pound. The amount of pentachlorobenzene was then summed for all chemicals at each facility. This sum was then used to determine whether a facility would submit a report for pentachlorobenzene under each lowered threshold. To avoid double counting, this analysis of facilities in SIC codes 20-39, which are manufacturing chemicals in which pentachlorobenzene is a byproduct or impurity, does not include facilities already included in other parts of the analysis.

Processing or Otherwise Using Chemicals In Which Pentachlorobenzene Is A Byproduct Or Impurity (SIC Codes 20 Through 39)

Pentachlorobenzene may be processed or otherwise used as a byproduct or impurity during the processing or otherwise use of chlorinated organics or pesticides, based on the assumption that all chemicals that contain hexachlorobenzene as an impurity also contain pentachlorobenzene as an impurity in the same concentrations (PEI, 1985). The total amount of pentachlorobenzene processed or otherwise used, and the number of facilities in this category were calculated in the same manner as those in the “Manufacturing Chemicals In Which Pentachlorobenzene Is A Byproduct Or Impurity (SIC Codes 20 Through 39)” category, except the appropriate thresholds were used for processing (25,000 pounds) and otherwise use (10,000 pounds). Using this methodology, the total pentachlorobenzene processed or otherwise used as a byproduct or impurity on other chemicals was estimated to be 26,000 pounds/year. An estimated 3,113 facilities are potentially subject to TRI reporting for processing or otherwise using

chemicals in which pentachlorobenzene is a byproduct or impurity. To avoid double counting, this analysis did not include facilities that were included in any of the categories discussed above.

F.3.2 SUMMARY

Facilities manufacturing, processing, or otherwise using pentachlorobenzene that may submit TRI reports at the lower thresholds are presented in Table F-4, along with the results of the analysis. Included are facilities in industries reporting hexachlorobenzene in the 1995 TRI database and selected industries not currently subject to TRI reporting, including SIC codes 4953, 5169, and 7389.

TABLE F-4
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR PENTACHLOROBENZENE

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
4953	Commercial Hazardous Waste Treatment	162 (U.S. EPA 1997c)	0	2	2	2	2
5169	Chemicals and Allied Products-Wholesale	7	0	3 - 7	0 - 7	0 - 7	0 - 7
7389	Solvent Recovery Services	191	0	47	47	0	0
2865, 2869, 2879, 2812	Manufacturing of pentachlorobenzene	9 (U.S. EPA 1997b)	0	9	9	9	9
20-39	Manufacturing of Chemicals in which pentachlorobenzene is a byproduct or impurity	131	0	131	76 - 131	3 - 131	0 - 131
20-39	Use of chemicals in which pentachlorobenzene is a byproduct or impurity in production or other use	3,113	0	3,122	573 - 3,122	22 - 3,122	0 - 3,122
	TOTAL FOR ALL FACILITIES	**3,613**	**0**	**3,314 - 3,318**	**707 - 3,318**	**36 - 3,271**	**11 - 3,271**

F.4 CONCLUSIONS

As a result of lowering the TRI reporting thresholds, an estimated additional 11 to 3,318 reports may be anticipated for pentachlorobenzene, depending on the reporting threshold. The estimated number of reports at each threshold is presented below:

1 lb/yr - 3,314 to 3,318
10 lbs/yr - 707 to 3,318
100 lbs/yr - 36 to 3,271
1,000 lbs/yr - 11 to 3,271

LITERATURE CITED

1. Agency for Toxic Substances and Disease Registry (1990). Public Health Statement. http://atsdr1.atsdr.cdc.gov:8080/ToxProfiles/phs9017.html. Downloaded 12/3/97.

2. Aluminum Association, The (1998). Memorandum to Robert Bailey (Bailey Associates) regarding a review of the draft report "Global Hexachlorobenzene Emissions". April 29.

3. British Horological Institute (ND). Poisons and Horological Materials. http://www.bhi.co.uk/hints/poison.htm.

4. CEISIN (ND). Pollutant: Pentachlorobenzene. http://epawww.ciesin.org:7777/glre...elim/pvegl/pentachlorobenzene.html.

5. Eastern Research Group (1998). Survey of Facilities Reporting to TRI Under SIC 5169. June.

6. Knutzen, J. and M. Oehme (1989). "Polychlorinated Dibenzofuran (PCDF) and Dibenzo-p-dioxin (PCDD) Levels in Organisms and Sediments from the Frierfjord, Southern Norway." Chemosphere, Volume 18, Number 12.

7. Kroschwitz, I. ed. (1994). Kirk-Othmer's Encyclopedia of Industrial Chemicals. 4th ed. John Wiley and Sons. New York.

8. New Jersey Department of Health (1988). Hazardous Substances Fact Sheet: Hexachlorobenzene.

9. PEI Associates, Inc. (1985). Sources of Hexachlorobenzene, John Spessard, Contract No. 68-02-4248.

10. Sine, Charlotte ed. Farm Chemicals '94 (1994). Meister Publishing Company. Willoughby, Ohio.

11. Spectrum Laboratories (ND). Chemical Fact Sheet. http://www.speclab.com/compound/c118741.htm

12. Spectrum Laboratories (ND). Chemical Fact Sheet. http://www.speclab.com/compound/c608935.htm

13. Spectrum Laboratories (ND). Chemical Fact Sheet. http://www.speclab.com/compound/c127184.htm

14. U.S. Census Bureau. 1992 Census of Manufactures - Industry Series. Department of Commerce

15. U.S. Census Bureau. 1995 County Business Patterns.

16. U.S. EPA (1997a). RCRA Biennial Reporting System (BRS) for Hazardous Waste. Office of Solid Waste. 1995.

17. U.S. EPA (1997b). 1995 Toxics Release Inventory (TRI) Database. Office of Pollution Prevention and Toxics.

18. U.S. EPA (1997c). Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313. Office of Pollution Prevention and Toxics. April.

19. U.S. EPA (1997d). 1990 Emissions Inventory of Section 112 (c)6 Pollutants. Emissions, Monitoring and Analysis Division and Air Quality Strategies and Standards Division. Research Triangle Park, North Carolina. June.

20. U.S. EPA (1986). Final Draft Report - Exposure Assessment for HCB. Office of Toxic Substances, May 14.

21. U.S. EPA (1993). Estimation of National Hexachlorobenzene Emissions for 1990, Final Report. Office of Air Quality Planning and Standards, October.

22. U.S. EPA (1984). Sources of Polychlorinated Styrenes in the Great Lakes and their Tributaries (1984). U.S. EPA Grant No. R00-5764-01.

23. U.S. EPA (1989). Drinking Water Health Advisory: Pesticides. Lewis Publishers, Inc. Chelsea, Michigan.

24. Verschueren, K. (1983) Handbook of Environmental Data on Organic Chemicals, 2nd Edition . Van Nostrand Reinhold, New York.

25. Westberg, H. et al. (1997). Emissions of Some Organochlorine Compounds in Experimental Aluminum Degassing with Hexachloroethane. Applied Occupational and Environmental Hygiene 12(3): 178-183. March.

PERSONAL COMMUNICATIONS

1. International Magnesium Association, McLean, Virginia (1998). Telephone call regarding the electrolytic production of metallic magnesium using carbon electrodes. August 19.

APPENDIX G
PESTICIDES:
ALDRIN, CHLORDANE, DICOFOL, HEPTACHLOR, ISODRIN, METHOXYCHLOR, PENDIMETHALIN, TOXAPHENE, TRIFLURALIN

This section contains a discussion of the pesticides that will be covered by the final rule.[1] A profile presenting information on production, use, and releases is presented below for each pesticide. Following the profiles, the methodology used to determine the number of additional TRI reports which would be expected for these pesticides under the lower reporting thresholds is described.

G.1 ALDRIN

Aldrin (CAS 309-00-2) is an organochlorine compound first introduced to the U.S. in 1950 as a cotton pesticide. It was used as an insecticide from the 1950s to early 1970s on cotton and corn crops. In 1974, all uses except termite control were canceled under FIFRA and production in the United States ceased. Aldrin was imported from 1974 to 1985, with the exception of a temporary pause in 1979 and 1980. Aldrin was not imported after 1985 due to health concerns and insect resistance (ATSDR, 1993).

G.1.1 PRODUCTION

Aldrin is a tan to dark brown solid created by condensing hexachlorocyclopentadiene (produced by the reaction of n-pentane and chlorine) with bicycloheptadiene (ECDIN, 1997). Trade names for aldrin include: Seedrin, Aldocit, Aldrex, Drinox, Kortofin, Octalene, Tatuzinho, and Tipula. Companies producing aldrin pesticides included J.R. Simplot Company, MFA Oil Company, Zeneca Inc., Conagra Fertilizer Company, Arizona Agrochemical Company, Spencer Plant Food Inc., and Coastal Chemical Corporation (EPA/OPP). In 1972, Shell Chemical Company in Denver, CO produced an estimated 13 million pounds of aldrin (EPA, 1975).

In 1970, the U.S. Department of Agriculture canceled all uses of aldrin based on the concern that these chemicals could cause severe aquatic environmental change and are potentially carcinogenic. Early in 1971, EPA initiated cancellation proceedings for aldrin, but did not order the suspension of aldrin use. In 1972, under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act as amended by the Federal Pesticide Control Act of 1972, an EPA order lifted the cancellation of aldrin use in three cases: subsurface ground insertion for termite control; dipping of nonfood plant roots and tops; and moth-proofing in manufacturing processes using completely closed systems. In 1974, the latter two registered uses were voluntarily abandoned by the registrant, Shell Chemical Company. Also in 1974, EPA issued a final decision canceling all

[1]At this time, EPA is deferring its decision on whether to classify dicofol as a PBT chemical. Dicofol will continue to be reported at current reporting thresholds.

uses of aldrin except those exempted in 1972. EPA was petitioned in 1987 to ban aldrin, and the final registered use of aldrin was voluntarily canceled by Shell in 1987 (ATSDR, 1993).

G.1.2 USES AND RELEASES

Aldrin was used as a soil insecticide to control root worms, beetles, and other crop pests, and as a treatment for timber, plastic and rubber coverings to control termites and other pests. Aldrin use peaked in 1966 at 19 millions pounds but had dropped to 10.5 million pounds by 1970. Because aldrin is not currently produced or imported into the U.S., its use is believed to be minimal.

A number of states and local governments sponsor "Clean Sweep" programs to encourage the proper disposal of banned and/or restricted pesticides. From 1990 to 1996, the Minnesota Pollution Control Agency's Clean Sweep Program collected 3,113 pounds of aldrin through this program (Minnesota, 1989). Washington State Department of Agriculture collected thirty pounds and five gallons of aldrin on September 27, 1990 in Franklin County, WA (Washington, 1991).

Although aldrin is reportable to the Toxic Release Inventory, no reports were received for aldrin in 1996.

G.2 CHLORDANE

Chlordane (CAS 57-74-9) is a organochlorine compound used as a broad-spectrum pesticide which was first marketed in 1948 in a variety of formulations. Concern over the health effects and particularly the carcinogenicity of chlordane lead to an eventual ban on all domestic uses of chlordane in 1988.

G.2.1 PRODUCTION

Pure chlordane is a white crystalline solid with a mild, pungent odor (EHC, 1997). Chlordane is produced by chlorinating cyclopentadiene to form hexachlorocyclopentadiene and condensing the latter cyclopentadiene to form chlordene. The addition of chlorine to a chlordene intermediate yields chlordane and heptachlor (ATSDR, 1994). Technical grade chlordane contains a maximum 7% heptachlor as well as a mixture of at least 140 related chemicals.

Chlordane was the first member of the powerful organochlorine insecticides discovered after WWII. Chlordane was manufactured in the United States from 1948 to 1988 for domestic use and marketed under the trade names of Octa-Klor (Chevron), Velsicol 1068 (Velsicol), Aspon-chlordane (Faesy & Besthoff, Inc.), Synklor (Tamogen) and Termi-Ded (Rigo) (Sine, 1994). Production of chlordane peaked in the 1970's at 24.9 million lbs/year and dropped substantially in the late 1970's and early 1980's due to concern about its health effects (Glooschenko and Lott, 1977). Following the domestic use ban in 1988, chlordane was produced solely for export by Velsicol Chemical Corporation. In 1997 Velsicol announced the production phase-out of chlordane (Rotman, 1997).

G.2.2 USES AND RELEASES

Chlordane was once widely used as an insecticide on corn, citrus, and home gardens and as a fumigant in termite and carpenter ant control. During the its peak usage in the 1970's, the distribution of chlordane use was as follows: 35% for pest control of termites and carpenter ants; 30% on home and garden use; 28% on agricultural crops; and 7% on turf and ornamentals (IARC, 1979). In 1978 a cancellation notice was issued that banned all uses of chlordane except for root dipping of non-food plants and underground treatment against termites. The minor use allowance of chlordane treatment on non-food plants was canceled in 1983, and the subterranean use of chlordane for termite control was banned in 1988.

A number of states and local governments sponsor "Clean Sweep" programs to encourage the proper disposal of banned and/or restricted pesticides. Four state sponsored hazardous waste collection campaigns (MN, NY, TX and WA) in the early 1990's reported that over 12,000 lbs. of chlordane was collected in these campaigns (Minnesota, 1989, County of Erie, 1994, Texas, 1990, Washington, 1990).

Releases of chlordane are reported in the Toxic Release Inventory and numbers of reports are shown in the following table. The total Section 8.1 releases in 1996 were 755 pounds. A total of 4,989 pounds of chlordane was reported to TRI under Section 8 (8.1-8.8), which includes releases, energy recovery, recycling, treatment, and one-time releases.

TABLE G-1
1996 TRI REPORTING FOR CHLORDANE

SIC code	Number of Form Rs	Number of Form As
2865 Cyclic Organics	1	0

Source: Toxic Release Inventory 1996, USEPA

G.3 DICOFOL

Dicofol (CAS 115-32-2) is a chlorinated hydrocarbon used as an agricultural pesticide. Dicofol was first commercialized in 1955.

G.3.1 PRODUCTION

Dicofol is either a pure white solid or a yellow to dark brown viscous oil. It is produced by the chlorination of 1,1-bis (4-chlorophenyl) ethanol or the chlorination of DDT in the presence of formic acid (ECDIN). Dicofol is also known by its trade name, Kelthane. Other trade names for dicofol include Acarin, Cekudifol, Decofol, Dicomite, Hifol, and Mitigan (EXTOXNET).

G.3.2 USES AND RELEASES

Dicofol is used on 19 crops as an insecticide and an acaricide (mite and other small insect pesticide), primarily cotton, citrus, and dry beans (Gianessi, 1995). It is also used in or around agricultural and domestic buildings for mite control (Spectrum).

Releases of dicofol are reported in the 1996 Toxic Release Inventory and numbers of reports are shown in the following table. Total Section 8.1 releases in 1996 were 210 pounds. A total of 329 pounds of dicofol was reported under Section 8 (8.1-8.8), which includes releases, energy recovery, recycling, treatment, and one-time releases.

TABLE G-2
1996 TRI REPORTING FOR DICOFOL

SIC code	Number of Form Rs	Number of Form As
2875 Mixed Fertilizers	1	0
2879 Pesticides	1	2
Total	2	2

Source: 1996 Toxic Release Inventory, USEPA

G.4 HEPTACHLOR

Heptachlor (CAS 76-44-8) is an organochlorine insecticide which was first isolated from technical chlordane in 1946. It is presently only used in the U.S. to control fire ants in buried, pad-mounted electric power transformers and in underground cable television and telephone cable boxes (EPA, 1992). In 1974, EPA issued a Notice of Intent to Cancel all registered uses of heptachlor except those for subterranean termite control and dipping of non-food plants. Most uses of heptachlor were canceled in March 1978.

G.4.1 PRODUCTION

Heptachlor is a white powder that smells like mothballs (camphor). It is produced by the chlorination of chlordane (ECDIN). Technical heptachlor contains twenty percent chlordane. Trade names include Heptagram, Heptox, H-34 Heptamul, Goldcrest H-60, Basaklor, Drinox, Soleptax, Termide, and Velsicol 104, all produced by Velsicol Chemical Corporation (EXTOXNET).

Production of heptachlor in 1982 was nearly 100,000 pounds, all of which was used as a non-agricultural insecticide (Drinking Water and Health). EPA was petitioned in 1987 to ban heptachlor and related pesticides due to adverse health effects (CMR, 1987).

Velsicol Chemical Corporation continued to export at least 5.7 million pounds of heptachlor between 1991 and 1994. This company exported heptachlor products in 1995 to

India, Pakistan, and Bangladesh (EPA, 1995). Velsicol announced in May 1997 that it is permanently ceasing production of heptachlor and expects to sell out its remaining stocks by the end of 1997 (Rotman, 1997).

G.4.2 USES AND RELEASES

Heptachlor was first registered in the U.S. in 1952 for use as a broad spectrum insecticide on many agricultural crops. Heptachlor was also used for home and garden insect control, for termite control, and as a seed treatment (EPA, 1992). Use slowed in the 1970s and ceased in the 1980s (ATSDR, 1993). In 1989, all heptachlor tolerances were revoked and replaced with action levels (EPA, 1992).

A number of states and local governments sponsor "Clean Sweep" programs to encourage the proper disposal of banned and/or restricted pesticides. The Minnesota Pollution Control Agency collected 2,483 pounds of heptachlor from 1990 to 1996 as part of their Clean Sweep Program (Minnesota, 1989).

Releases of heptachlor are reported in the 1996 Toxic Release Inventory and numbers of reports are shown in the following table. The amount of Section 8.1 heptachlor releases reported by the cyclic crudes industry was 203 pounds. A total of 18,514 pounds of heptachlor was reported under Section 8 (8.1-8.8), which includes releases, energy recovery, recycling, treatment, and one-time releases.

TABLE G-3
1995 TRI REPORTING FOR HEPTACHLOR

SIC code	Number of Form Rs	Number of Form As
2865 Cyclic crudes	1	0

Source: 1996 Toxic Release Inventory, USEPA

G.5 ISODRIN

Isodrin (CAS 465-73-6) is an insecticide which was never commercially used and is no longer used or manufactured in the U.S. (Cremlyn, 1978).

G.5.1 PRODUCTION

Isodrin is a white crystalline solid (ECDIN). Isodrin is made by the slow reaction of cyclopentadiene with the condensation product of vinyl chloride and hexachlorocyclopentadiene (Matin, 1971).

G.5.2 USES AND RELEASES

Although isodrin is reportable to the Toxic Release Inventory, no reports were received for isodrin in 1996.

G.6 METHOXYCHLOR

Methoxychlor (CAS 72-43-5) is an organochlorine used as an insecticide to control a wide variety of insects on agricultural crops, livestock, grain storage, home gardens, and pets.

G.6.1 PRODUCTION

Methoxychlor is a pale-yellow powder with a slightly fruity or musty odor. Methoxychlor is produced by reacting anisole with chloral, catalyzed by aluminum chloride (ECDIN). Trade names for methoxychlor include Prentox, Methoxcide, DMDT, Marlate, Chemform, Methoxy-DDT, and Metox (EXTOXNET and ATSDR, 1994).

In 1975, three U.S. companies produced approximately 5.5 million pounds of methoxychlor. In 1982, production had fallen to 3 million pounds. In 1994, Kincaid Enterprises Inc. in Nitro, West Virginia was the sole producer of methoxychlor in the U.S. (ATSDR, 1994).

G.6.2 USES AND RELEASES

Methoxychlor is used on agricultural crops, livestock, grain storage, home gardens, and pets. EPA has approved the use of methoxychlor as a pesticide and fumigant on more than 85 crops such as fruits, vegetables, forage crops, and shade trees. It may also be applied to large areas such as beaches, estuaries, and marshes for control of flies and mosquito larvae and may be used for spray treatment of barns, grain bins, mushroom houses, other agricultural premises, and garbage and sewage areas (ATSDR, 1994). In 1982, it was estimated that methoxychlor was used as follows: 43 percent as an insecticide for livestock and poultry, 29 percent on alfalfa crops, and 29 percent on citrus (Drinking Water and Health). In 1995, methoxychlor was used on eight crops, primarily apples (69,936 out of 88,907 pounds of active ingredient) (Gianessi, 1995).

Companies using methoxychlor as a formulation components include: Drexel Chemical Company, Chevron Chemical Company, Prentiss Drug and Chemical Company, and Platte Chemical Company. Formulations include wettable powders, dust, granules, emulsifiable concentrates, flowable concentrates, liquid soluble concentrates, ready-to-use products, and pressurized liquids (ATSDR, 1994).

Releases are expected to be the result of use as an insecticide, loss during manufacturing, formulation, packaging, and disposal. The following table contains the number of forms submitted to the 1996 Toxic Release Inventory. Section 8.1 releases of methoxychlor equaled 11 pounds. A total of 818 pounds was reported under Section 8 (8.1-8.8), which includes releases, energy recovery, recycling, treatment, and one-time releases.

TABLE G-4
1996 TRI REPORTING FOR METHOXYCHLOR

SIC code	Number of Form Rs	Number of Form As
2879 Pesticides and Agricultural Chemicals	1	0
2899 Miscellaneous Chemical Products, Not Elsewhere Classified	2	0

Source: 1996 Toxic Release Inventory, USEPA

G.7 PENDIMETHALIN

Pendimethalin (CAS 40487-42-1) is used as an insecticide and herbicide. It is also known as benzenamine. Pendimethalin was first registered as a pesticide in 1972 and marketed in 1976 (EPA, 1997).

G.7.1 PRODUCTION

Pendimethalin is a orange-yellow crystalline solid and is formulated as a liquid, solid, granular, emulsifiable concentrate, and a dry flowable (EXTOXNET). Pendimethalin is produced by the reaction of N-(1-ethylpropyl)amine with 2,6-dinitro-3,4-dimethylchlorobenzene, which is obtained by nitrating p-chloro-o-xylene in the presence of sulfuric acid. It is also produced by reacting o-xylene with diethyl ketone in the presence of nitric or sulphuric acid (ECDIN).

Trade names for pendimethalin include Penoxalin, Herbadox, Prowl, Prozine, Pentagon, Stomp, Accotab, Go-Go-San, Wax Up, Pay-off, Sipaxol, Squadron, Pendulum, Pursuit Plus, and Xylidine (ChemFinder). The Scotts Company produces it under the name Scotts Progrow (Farm Chemicals Handbook, 1997).

American Cyanamid is the largest producer of pendimethalin. American Cyanamid's pendimethalin was the tenth best-selling pesticide in 1995, with $152 million in sales (CMR, 1995).

G.7.2 USES AND RELEASES

Pendimethalin is used as a preemergence and postemergence herbicide on cotton, dry bulbs, onions, dry bulb shallots, edible beans, corn, legumes, garlic, grain, nonbearing fruit, nut crops, peanuts, potatoes, rice, soybeans, sugar cane, sunflowers, sweet corn, and sweet lupine (Farm Chemicals Handbook, 1997). It is also used for preemergence control of many annual grasses and certain broadleaf weeds (EXTOXNET).

Pendimethalin is applied by broadcasting, directed spray, and soil treatment. EPA estimates that 23-28 million pounds of pendimethalin active ingredient were used in U.S. agricultural crop production in 1995 (Aspelin, 1997). Currently, 58 pendimethalin products are registered for agricultural, domestic, and commercial uses (EPA, 1997).

Releases of pendimethalin are reported in the 1996 Toxic Release Inventory and numbers of reports are shown in the following table. A total of 3,234 pounds of pendimethalin was released and reported under Section 8.1. A total of 160,278 pounds was reported under Section 8 (8.1-8.8), which includes releases, energy recovery, recycling, treatment, and one-time releases.

TABLE G-5
1996 TRI REPORTING FOR PENDIMETHALIN

SIC code	Number of Form Rs	Number of Form As
2875 Mixed Fertilizers	2	0
2879 Pesticides	3	1
Total	5	1

Source: 1996 Toxic Release Inventory, USEPA

G.8 TOXAPHENE

Toxaphene (CAS 8001-35-2) is a polychlorinated camphene which was widely used as an insecticide from its introduction in 1947 until its registration was canceled in 1982, except for emergency use for corn, cotton, and small grains for specific insect infestation (USDA, 1995). Existing stocks were used without restrictions until 1986 (Eisler, 1985). All uses were banned in 1990 (ATSDR, 1997).

G.8.1 PRODUCTION

Toxaphene is a waxy solid, yellow to amber in color, smelling similar to turpentine (ECDIN). It is a complex mixture of at least 670 chlorinated terpenes. Technical toxaphene can be produced commercially by reacting chlorine gas with technical camphene in the presence of ultraviolet radiation and catalysts, yielding chlorinated camphene containing 67-69 percent chlorine by weight. It has been available in various forms: as a solid, solution, wettable powder, dusts, granules, and emulsifiable concentrates (ATSDR, 1996).

Toxaphene is also known as chlorinated camphene, Synthetic 3956, Octachlorocamphene, Alltox, Geniphene, Toxakil, Polychloroamphene, Camphechlor, Clor Chem T-590, Cristoxo, Moto, Phenacide, Phenatox, Strobane-T, Toxon 63, and Vapotone (Eisler, 1985). It was produced by Hercules Incorporated, Tenneco, Sonford Chemical Company, Miller Chemical and Fertilizer Corporation, FCX Incorporated, Economy Products, and Vicksburg Chemical Company (ATSDR, 1996).

In 1974, an estimated 44 million pounds of toxaphene were used in the U.S. (Gips, 1990). Average toxaphene consumed between 1964 and 1976 was 36 million pounds per year (USDA, 1978). In 1972, Hercules Inc., in Georgia, and Tenneco Chemicals Inc., in New Jersey, had plant capacities of 50-75 million pounds and 125 million pounds respectively (USEPA, 1975). Production of toxaphene in 1977 was nearly 40 million pounds. According to one source, by 1982, when most of its uses were canceled, consumption was reported to be 12 million pounds, production was between 16 and 20 million pounds, imports were 4 million pounds, and exports were 10 to 12 million pounds (NTP, 1997). Another source reports toxaphene production in 1982 as only 3.7 million pounds (ATSDR, 1996).

G.8.2 USES AND RELEASES

Toxaphene is an insecticide that was primarily used in the southern U.S. to control pests on cotton (50 percent), vegetables (17 percent), livestock and poultry (17 percent), soybeans (12 percent), and alfalfa, wheat, and sorghum (5 percent). Other uses included controlling unwanted fish growth in lakes and pests on livestock. All registered uses of toxaphene in the U.S. were canceled in 1990 (ATSDR, 1996). It is still commonly used as an insecticide on bananas and pineapples in Puerto Rico and the Virgin Islands (ATSDR, 1997).

A number of states and local governments sponsor "Clean Sweep" programs to encourage the proper disposal of banned and/or restricted pesticides. The Texas Water Commission collected 35 drums (drums ranged from 14-80 gallons) of toxaphene on the 1990 Pesticide Amnesty Day (Texas, 1990). The Minnesota Pollution Control Agency collected 11,814 pounds of toxaphene from 1990 to 1996 as part of their Clean Sweep Program (Minnesota, 1989). The Washington State Department of Agriculture collected 70 gallons of toxaphene on their Pesticide Waste Collection Day in 1990, in Franklin County, WA (Washington, 1991).

Toxaphene is currently reportable to the Toxic Release Inventory, however there were no reports filed for toxaphene in 1996.

G.9 TRIFLURALIN

Trifluralin (CAS 1582-09-8) is an herbicide used primarily on cotton and soybean crops. Production of trifluralin has declined since restrictions on product formulation were implemented in 1982 due to carcinogenicity and mutagenicity concerns (USDA, 1995).

G.9.1 PRODUCTION

Trifluralin is a yellow-orange crystalline solid made by the reaction of di-n-propylamine with 2,6-dinitro-4-trifluoromethylchlorobenzene (ECDIN).

Trade names include Flurene SE, Trust, Triflualina 6000, Elancolan, Su Seguro Carpidor, Trafanocide, Treficon, Trim, Crisalin, Triflurex, and Ipersan. Eli Lilly & Company was the sole producer of Treflan until it went off patent. Eli Lilly (fungicides) merged with Dow Chemical

(insecticides) in 1989 to form Dow Elanco (CMR, 1989). Dow Elanco, in Lafayette, Indiana, produces trifluralin in the U.S. under the trade name Treflan. Other manufacturers include Mahkteshin-Agan, Tri Corporation, and Albaugh Inc. (EPA, 1996).

Dow Elanco's trifluralin was reported to be the fourth best-selling pesticide in the US in 1995, with $205 million in sales (CMR, 1995). Griffin also produces trifluralin under the trade name Trilin and Koor Industries produces trifluralin under the trade name Triflurex.

G.9.2 USES AND RELEASES

Treflan is a selective preemergence herbicide that is incorporated into the soil for the control of annual grasses and weeds in terrestrial food and feed crops (EXTOXNET). Approximately 70 percent of trifluralin is used on soybean crops, the rest is used on cotton, wheat, alfalfa, sunflowers and many other crops. EPA estimated that between 23 to 28 million pounds of trifluralin active ingredient were used in agricultural crop production annually in 1987, 1993, and 1995 (Aspelin, 1997). Another estimate of trifluralin use in 1995 was 25.6 million pounds (Gianessi, 1995).

A number of states and local governments sponsor "Clean Sweep" programs to encourage the proper disposal of banned and/or restricted pesticides. The Washington State Department of Agriculture collected 8.5 gallons of trifluralin on September 27, 1990, in Franklin County, WA on their Pesticide Waste Collection Day (Washington, 1991).

Releases of trifluralin are reported to the 1996 Toxic Release Inventory and numbers of reports are shown in the following table. A total of 66,479 pounds of trifluralin was released and reported under Section 8.1 of TRI. A total of 286,659 pounds was reported under Section 8 (8.1-8.8), which consists of releases, energy recovery, recycling, treatment, and one-time releases.

TABLE G-6
1996 TRI REPORTING FOR TRIFLURALIN

SIC code	Number of Form Rs	Number of Form As
2834 Pharmaceuticals	1	0
2875 Mixed Fertilizers	3	0
2879 Pesticides	12	3
3999 Miscellaneous Manufacturing	1	0
No SIC Reported	1	0
TOTAL	18	3

Source: 1996 Toxic Release Inventory, USEPA

G.10 ESTIMATED NUMBER OF TRI REPORTS ON PBT PESTICIDES AT LOWER THRESHOLD LEVELS

The number of additional pesticide-related TRI reports that facilities would submit under lower reporting thresholds is estimated based on the number of facilities that manufacture, process, or otherwise use each pesticide in excess of the lower threshold amount. For each pesticide, the number of reports relating to manufacturing and processing was estimated separately from the number of reports relating to otherwise use.

G.10.1 MANUFACTURE AND PROCESS

Data on facilities that manufacture or process pesticides were drawn from information reported to EPA under Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Section 7 of FIFRA requires pesticide-producing establishments to register with EPA and report annually the types and amounts of pesticides produced, sold, or distributed in the last year (40 CFR Part 167). Establishments must report if they manufacture, import, formulate, or repackage a pesticide. This analysis used information on the amounts reported under FIFRA Section 7 to estimate how many facilities would exceed each lower threshold. The amounts reported by individual facilities are Confidential Business Information under FIFRA.

The number of TRI reports expected for the facilities manufacturing or processing at lower reporting thresholds was estimated using the following steps:

1) Count the number of domestic facilities in EPA's FIFRA Section 7 Tracking System (SSTS) that reported manufacturing, formulating, or repackaging a listed active ingredient in 1995 above the lower threshold amount.

2) For dicofol, methoxychlor, pendimethalin, and trifluralin, apply a pesticide-specific factor to account for facilities that report under Section 7 but are not in TRI-subject SIC codes.

3) Apply a factor to account for facilities submitting Form As that were not accurately predicted under step 2.

4) Apply a factor to account for facilities that are not required to report because they do not meet the employment size threshold.

5) Sum the predicted number of reports across the affected pesticides at each lower reporting threshold.

While Section 7 of FIFRA does not require reporting from farmers, commercial applicators, pesticide dealers, or custom blenders (who mix end use products as part of an application process), it does appear that some facilities that are not in the manufacturing SIC codes (20-39) have reported. During the development of effluent guidelines for the pesticide industry, EPA's Office of Water (OW) conducted a statistical survey of facilities reporting under Section 7 in 1988. A review of the survey shows that 68 percent of facilities reporting for dicofol,

methoxychlor, pendimethalin, and trifluralin were not in the manufacturing SIC codes (ERG Incorporated, 1998). Based on survey responses, these facilities were determined to be agrichemical dealers, and these facilities were assigned SIC code 5191. The remaining facilities were predominantly in SIC 287: agricultural chemicals. To account for facilities that are not in an SIC code subject to TRI reporting, a pesticide-specific factor was applied to the number of facilities drawn from Section 7 reports for dicofol, methoxychlor, pendimethalin, and trifluralin. Based on the results of the OW survey, these pesticide-specific factors were calculated as the percentage of the total number of reports submitted under FIFRA Section 7 that would be expected from facilities in the manufacturing SIC codes.

To verify the validity of the resulting estimates of reports, the expected number of TRI reports for dicofol, methoxychlor, pendimethalin, and trifluralin based on FIFRA Section 7 reports was compared to the actual number of 1995 TRI reports for these pesticides. At current reporting thresholds, this approach resulted in an estimate that exactly matched the number of Form R reports (26). There were, however, an additional eight Form A certification statements that were not predicted. Therefore, a factor of 1.3 (34/26 = 1.3) was applied to the estimates of number of facilities in TRI-subject SIC codes to adjust for this difference. After applying this factor, the predicted number of TRI reports for 1995 equaled the actual number of TRI reports (34) for dicofol, methoxychlor, pendimethalin, and trifluralin.

The agricultural chemicals sector (SIC 287) is almost evenly divided between facilities with fewer than ten employees which are not subject to TRI reporting, and facilities with ten or more employees which are subject to TRI reporting. One further adjustment was made to the estimates of additional reports to account for facilities that would not report to TRI because they do not meet the employment threshold. In 1995, 506 of the 951 facilities (53%) in SIC 287 had 10 or more employees (U.S. Bureau of the Census, 1995). For this analysis, it was assumed that approximately half (47%) of the facilities manufacturing or processing less than 1,000 pounds of a pesticide would not be subject to TRI reporting because they do not have 10 or more employees.

The following table summarizes the estimated number of additional TRI reports at lower reporting thresholds for the manufacture and/or processing of the pesticides. The estimated number of additional reports from facilities that manufacture and process pesticides at the lower threshold levels is not given for individual pesticides since reporting this information could disclose confidential business information (CBI). To maintain confidentiality, the results presented here are aggregated for all pesticides under consideration. There is a FIFRA CBI support document that contains the estimated number of reports for each pesticide (EPA, 1998).

In the table, “Option 1” corresponds with a reporting threshold of 10 lbs for aldrin, methoxychlor, pendimethalin, and trifluralin and 1 lb for chlordane, dicofol,[2] heptachlor, isodrin, and toxaphene. “Option 2” corresponds with a reporting threshold of 100 lbs for aldrin,

[2]At this time, EPA is not promulgating a lower reporting threshold for dicofol. To protect FIFRA CBI information, the estimates of expected additional TRI reporting due to manufacture and processing of PBT pesticides have not been changed. The actual impact without a lower reporting threshold for dicofol would be slightly lower.

methoxychlor, pendimethalin, and trifluralin and 10 lbs for chlordane, dicofol,[2] heptachlor, isodrin, and toxaphene. "Option 3" corresponds with a reporting threshold of 1,000 lbs for aldrin, methoxychlor, pendimethalin, and trifluralin, and 100 lbs for chlordane, dicofol,[2] heptachlor, isodrin, and toxaphene. "Option 4" corresponds with a reporting threshold of 1,000 lbs for all the pesticides. Reporting thresholds apply to manufacture, process and otherwise use of Section 313 chemicals.

TABLE G-7
EXPECTED ADDITIONAL TRI REPORTING ON PBT PESTICIDES
MANUFACTURE & PROCESS

Reporting Threshold	Aggregate Additional Reports for Manufacture or Process
Option 1	256
Option 2	246
Option 3	181
Option 4	181

G.10.2 OTHERWISE USE

In general, facilities that otherwise use the chemicals in pesticidal applications (i.e., agriculture and forestry operations) are exempt from reporting because they are in SIC codes that are not required to report to TRI. However, as a result of a recent interpretation of the definition of "otherwise use", facilities that receive a toxic chemical for waste management purposes are required to include that chemical in threshold determinations.

It is expected that some RCRA subtitle C facilities in SIC 4953 will receive sufficient quantities of the pesticides to require reporting at a lower reporting threshold. As noted in the previous sections, a number of states and local governments sponsor "Clean Sweep" programs to encourage the proper disposal of banned and/or restricted pesticides. While there is no comprehensive national summary of pesticide quantities collected in "Clean Sweep" programs, some of these programs have reported collecting tens to hundreds of pounds of aldrin, chlordane, heptachlor, toxaphene, and trifluralin in recent years. The collected pesticides are disposed as hazardous waste. In addition, facilities that manufacture pesticides may also send production wastes for disposal.

The following table summarizes the number of reports expected for the TRI PBT pesticides from RCRA subtitle C facilities in SIC 4953 at lower reporting thresholds. The estimates are derived from National Hazardous Waste Constituent Survey. This survey of hazardous waste treatment, disposal and recycling facilities was designed and conducted by the U.S. EPA Office of Solid Waste (OSW). Information on the constituents of up to 20 major waste streams was obtained from each of 156 facilities. For the purposes of the study, a major waste

stream was defined as being greater than 400 tons for non-wastewaters and 40,000 tons for wastewaters. Dicofol and isodrin did not appear in the survey responses (ICF, 1997).

The numbers of reports in the following table reflect the number of unique facilities reporting each pesticide as present at the facility in the OSW survey. The reports were apportioned between the lower threshold levels based on the average per facility amount of the pesticide reported. The following estimates represent lower bound estimates to the extent that the pesticides are present at the threshold quantities in minor waste streams. In the table, "Option 1" corresponds with a reporting threshold of 10 lbs for aldrin, methoxychlor, pendimethalin, and trifluralin and 1 lb for chlordane, dicofol,[3] heptachlor, isodrin, and toxaphene. "Option 2" corresponds with a reporting threshold of 100 lbs for aldrin, methoxychlor, pendimethalin, and trifluralin and 10 lbs for chlordane, dicofol,[3] heptachlor, isodrin, and toxaphene. "Option 3"corresponds with a reporting threshold of 1,000 lbs for aldrin, methoxychlor, pendimethalin, and trifluralin, and 100 lbs for chlordane, dicofol,[3] heptachlor, isodrin, and toxaphene. "Option 4" corresponds with a reporting threshold of 1,000 lb for all the pesticides. Reporting thresholds apply to manufacture, process, and otherwise use of Section 313 chemicals.

TABLE G-8
EXPECTED ADDITIONAL TRI REPORTING ON PBT PESTICIDES: OTHERWISE USE

Reporting Threshold	Aggregate Additional Reports for Otherwise Use
Option 1	24
Option 2	18
Option 3	18
Option 4	5

G.10.3 SUMMARY

Table G-9 summarizes the total additional reporting on pesticides expected as a result of the final rule to lower reporting thresholds for PBT chemicals.

[3]At this time, EPA is not promulgating a lower threshold for dicofol. The estimates of additional TRI reporting due to otherwise use of PBT pesticides are not affected, since dicofol did not appear in the OSW survey used to generate these estimates.

TABLE G-9
EXPECTED ADDITIONAL TRI REPORTING ON PBT PESTICIDES

Reporting Threshold	Aggregate Additional Reports
Option 1	280
Option 2	264
Option 3	199
Option 4	186

LITERATURE CITED

1. Agency for Toxic Substances and Disease Registry (1993). Toxicological Profile for Aldrin/Dieldrin. U.S. Department of Health and Human Services, Public Health Service. April.

2. Agency for Toxic Substances and Disease Registry (1994). Toxicological Profile for Chlordane. U.S. Department of Health and Human Services, Public Health Service. May.

3. Agency for Toxic Substances and Disease Registry (1994). Toxicological Profile for Methoxychlor. U.S. Department of Health and Human Services, Public Health Service. May.

4. Agency for Toxic Substances and Disease Registry (1996). Toxicological Profile for Toxaphene. U.S. Department of Health and Human Services, Public Health Service. August.

5. Agency for Toxic Substances and Disease Registry Public Health Statement (1997). <http://atsdr1.atsdr.cdc.gov:8080/ToxProfiles/phs8801.html>

6. Aspelin, Arnold (1997). Pesticides Industry Sales and Usage, 1994 and 1995 Market Estimates. US EPA, Office of Prevention, Pesticides, and Toxic Substances. August.

7. Deb Bartram, Eastern Research Group, Incorporated (1998). Memo to Cody Rice (EPA) regarding the SIC Code Analysis for Pesticide Facilities (April 24).

8. ChemFinder Fact Sheet <http://chemfinder.camsoft.com/cgi-win/cfserver.exe>

9. Chemical Marketing Reporter (1987). "Chlordane Producer Defends Right to Market Termiticides," April 6.

10. Chemical Marketing Reporter (1995). "Farmers Ante Up Billions For Crop Protection Agents," December 18.

11. Chemical Marketing Reporter (1989). "Lilly Joins with Dow in Agricultural Products," April 24.

12. Chemistry and Industry (1995). "Industry Resigned to Toxics Treaty," n22, p906. Nov 20.

13. County of Erie (1994). Clean Sweep Demonstration Project: Erie County, New York. Division of Environmental Compliance Services. January.

14. Cremlyn, R.J. (1978). Pesticides: Preparation and Mode of Action, John Wiley & Sons Publishers, New York.

15. Drinking Water and Health: Contaminant Specific Technical Factsheets <http://www.epa.gov/OGWDW/dwh/t-soc>

16. ECDIN Chemical Fact Sheet <http://ulisse.etoit.eudra.org/cgibin_ecd/inter_query>

17. Eichers, Theodore and Szmedra, Philip (1990). "Pesticides," Seven Farm Input Industries, Economic Research Service, USDA. September.

18. Eisler, R., and Jacknow, J. Toxaphene hazards to fish, wildlife, and invertebrates: a synoptic review. US Fish and Wildlife Service Biological Report 85(1.4).26.

19. Environmental Health Center (1997). Chlordane Chemical Backgrounder. National Safety Council. July 1.

20. Extension Toxicology Network Chemical Fact Sheet <http://ace.orst.edu/info/extoxnet>

21. Farm Chemicals (1988). "Kelthane MF Miticide is Back," v151 n4, p12. April 1.

22. Farm Chemicals Handbook (1997). Meister Publishing Company.

23. Gianessi, Leonard and Anderson (1995). Pesticide Use in U.S. Crop Production: National Summary Report. National Center for Food and Agricultural Policy, Washington DC. February.

24. Gips, Terry (1990). "Toxaphene, DDT's Too Toxic Substitute," Breaking the Pesticide Habit. <ftp://alternatives.com/library/envchem/toxaphen.txt>

25. Glooschenko, V., J. Lott, and R. Frank (1977). The effects of chlordane on the green alga Scenedesmus quadicauda and Chlamydomonas sp. Canadian Journal of Botony 55:2866-2872.

26 ICF Consulting Group (1997). Memorandum to Linda Wunderlich (EPA) and Yvonne Watson (SAIC) regarding Ranking of Chemicals Using National Hazardous Waste Constituent Survey (NWHCS) (June 24).

27. International Agency for Research on Cancer (IARC) (1979). Chlordane.Int. Agen. Res. Cancer, Monographs. Eval. Carcinogen. Risk Chem. Hum. 20:45-65.

28. Martin, Hubert, ed. (1971). Pesticide Manual, Basic Information on the Chemicals used as Active Components of Pesticides, 2nd edition. British Crop Protection Council.

29. Minnesota Pollution Control Agency (1989). The Final Report of the Waste Pesticide Collection Pilot Project. June.

30. National Toxicology Profile Anticipated Carcinogens: Toxaphene Fact Sheet <http://ntp-db.niehs.nih.gov/htdocs/ARC/ARC_RAC/Toxaphene.html>

31. Pearson, Swackhamer, Eisenreich, and Long (1997). "Concentrations, Accumulations, and Inventories of Toxaphene in Sediments of the Great Lakes," Environmental Science and Technology, V31. Nov. 12.

32. Plimmer, Jack R. ed. (1977). Pesticide Chemistry in the 20th Century. American Chemical Society Symposium Series 37.

33. Rotman, David (1997). "Velsicol Quits Chlordane Business" Chemical Week, p. 34. May 28.

34. Sine, Charlotte ed. (1994). Farm Chemicals '94. Meister Publishing Company. Willloughby, OH.

35. Sittig, Marshall, ed. (1980). Pesticide Manufacturing and Toxic Materials Control Encyclopedia, Noyes Data Corporation.

36. Spectrum Laboratories fact sheet <http://www.speclab.com>

37. "<The Drins' (Aldrin, Dieldrin and Endrin): Persistent, Indiscriminate Toxics." (1990) <ftp://alternatives.com/library/envchem/drins.txt>

38. The Texas Water Commission (1990). Texas Pesticide Amnesty Day Program. December.

39. United States Department of Agriculture (1978). The Biological and Economic Assessment of Toxaphene. Technical Bulletin #1652. Nov. 30.

40. United States Department of Agriculture (1992). The Minnesota Waste Pesticide Collection Program-A Summary. Waste Pesticide/Container Disposal Unit.

41. U.S. Department of Commerce, Bureau of Census (1995). 1995 County Business Patterns. Washington, D.C.: Government Printing Office.

42. USDA (1995). Pesticide and Fertilizer Use and Trends in U.S. Agriculture, Economic Research Service, USDA. May.

43. U.S. EPA (1995). Exports of Never Registered, Canceled, or Suspended Pesticide Active Ingredients, Program Management and Support Division, Office of Pesticide Programs.

44. U.S. EPA (1986). Pesticide Fact Sheet: Chlordane Fact. Sheet Number 109. Office of Pesticides and Toxic Substances.

45. U.S. EPA (1998). Predicted Number of Facilities Reporting on Manufacture or Processing of PBT Pesticides Under Proposed Modifications to EPCRA Section 313 (FIFRA CBI). EETD/OPPT. (Office of Pollution Prevention and Toxics), December.

46. U.S. EPA (1997). Reregistration Eligibility Decision, Pendimethalin. Office of Prevention, Pesticides, and Toxic Substances. June.

47. U.S. EPA (1996). Reregistration Eligibility Decision, Trifluralin. Office of Prevention, Pesticides, and Toxic Substances. April.

48. U.S. EPA (1992). Reregistration Eligibility Decision Facts, Heptachlor. Office of Prevention, Pesticides, and Toxic Substances. March.

49. U.S. EPA/OPP Chemical Database <http://www.cdpr.ca.gov/pccode=045101>

50. U.S. Fish and Wildlife Service, Department of the Interior (1990). Chlordane Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Biological Report 85(1.21) Contaminant Hazard Reviews Report 21. July.

51. Washington State Department of Agriculture Waste Pesticide Program . Pesticide Management Division (1990).

APPENDIX H
POLYCYCLIC AROMATIC COMPOUNDS, AND BENZO(g,h,i)PERYLENE

H.1 CHEMICAL PROFILE

Polycyclic aromatic compounds (PACs), also known as polycyclic aromatic hydrocarbons (PAHs), are a group of over 100 different chemicals that are characterized by hydrogen and carbon arranged in two or more fused benzene rings (EPA, 1994). PACs originate from both natural and anthropogenic sources. As pure chemicals, PACs generally exist as colorless, white, or pale yellow-green solids. Most PACs do not occur alone in the environment; rather, they are found as a mixture of two or more PACs. High concentrations of PACs are present in substances such as crude oil, coal, coal tar pitch, creosote, and road and roofing tar. PACs are generally not destroyed, and in many instances are formed, at temperatures achieved during fossil fuel combustion.

The following 21 PACs are described in this chemical profile:

- 1-Nitropyrene (CAS 5522-43-0)
- 3-Methylcholanthrene (CAS 56-49-5)
- 5-Methylchrysene (CAS 3697-24-3)
- 7,12-Dimethylbenz(a)anthracene (CAS 57-97-6)
- 7H-Dibenzo(c,g)carbazole (CAS 194-59-2)
- Benzo(a)anthracene (CAS 56-55-3)
- Benzo(a)phenanthrene (CAS 218-01-9)
- Benzo(a)pyrene (CAS 50-32-8)
- Benzo(b)fluoranthene (CAS 205-99-2)
- Benzo(j)fluoranthene (CAS 205-82-3)
- Benzo(k)fluoranthene (CAS 207-08-9)
- Benzo(rst)pentaphene (CAS 189-55-9)
- Dibenz(a,h)acridine (CAS 226-36-8)
- Dibenz(a,j)acridine (CAS 224-42-0)
- Dibenzo(a,l)pyrene (CAS 191-30-0)
- Dibenzo(a,e)fluoranthene (CAS 5385-75-1)
- Dibenzo(a,h)anthracene (CAS 53-70-3)
- Dibenzo(a,e)pyrene (CAS 192-65-4)
- Dibenzo(a,h)pyrene (CAS 189-64-4)
- Fluoranthene (CAS 206-44-0)
- Indeno(1,2,3-cd)pyrene (CAS 193-39-5).

For the purpose of this analysis, these chemicals are profiled as a group. All of the above chemicals, with the exception of 3-methylcholanthrene (CAS 56-49-5) and fluoranthene

(benzo(j,k)fluoranthene, CAS 206-44-0), are currently reported to TRI as part of a single PAC category. EPA is adding these chemicals to the PAC category.

One other PAC, not currently listed under EPCRA Section 313, benzo(g,h,i)perylene (CAS 191-24-2) is discussed separately with regard to the number of possible TRI reports at lower reporting thresholds. The final rule will list benzo(g,h,i)perylene separately from the PAC category.

H.1.1 PRODUCTION

PACs are a byproduct of human and natural activities that are produced or emitted during thermal processes such as the incomplete combustion of organic compounds, pyrolysis, or the processing of fossil fuels, bitumens, or nonfossil fuels (EPA, 1997). Natural sources include forest fires and volcanoes. Anthropogenic emissions are generated by internal combustion engines, industrial, commercial, and residential fuel combustion, power generation, cigarette smoke, open burning, and incineration. Because of the large number of PACs, EPA has developed a surrogate approach for estimating PAC emissions. The three most common surrogates are: EOM - the solvent extractable fraction; 7-PAH - the total emissions of seven PACs that are probable human carcinogens; and 16-PAH - the total emissions of the 16 PACs measured in EPA Method 610 (EPA, 1997a). All seven of the PACs in the 7-PAH category are included in the PAC group of 21 being considered in this document. These same seven PACs and benzo(g,h,i)perylene are included in the 16-PAH category. Table H-1 lists PAC air emission sources and amounts as reported for each of these surrogate groups for 1990 (EPA, 1998a).

As shown in Table H-1, the estimated total 1990 air emissions of 16-PAH were approximately 55 million pounds. The three largest source categories accounted for 63 percent of the total 16-PAH emissions. Almost 18 million pounds (33%) was estimated to come from residential wood combustion; approximately 11.5 million pounds (21%) from consumer product usage; and just over 5 million pounds (9%) from wildfires and prescribed burning. These sources are not reportable to TRI. The major industrial contributors were: the aerospace industry with about 3.25 million pounds (6%); coke ovens (various activities) with about 2.25 million pounds (4%); petroleum refining (all processes) with about 2.2 million pounds (4%); and primary aluminum production with about 1.3 million pounds (2%). In general, these sources are subject to TRI reporting requirements.

Of the profiled PACs, benzo(a)pyrene is the most documented. Benzo(a)pyrene [B(a)P] is a slightly odorous, pale yellow crystalline solid (CalEPA, 1993). B(a)P is a byproduct of combustion and is also found in creosote, which is a brown, heavy, oily liquid that comes from the high-temperature treatment of coal or wood. Creosote can also be extracted from the resin of the creosote bush. Coal-tar creosote is the most widely used wood preservative in the United States. Creosote can only be used by certified applicators and is strictly monitored by OSHA. Sources of lesser significance are cement, lime, silicon carbide, asphalt roofing manufacturing, creosote and wood preserving plants, road surfacing, municipal wastewater effluent, and domestic creosote use (ATSDR, 1990).

TABLE H-1
SUMMARY OF 1990 AIR EMISSIONS INVENTORY FOR PACS (TONS/YR)

SOURCE CATEGORY	PACs		
	7-PAH	16-PAH	EOM
Wildfires and Prescribed Burning	9.64e+02	2.54e+03	
Residential Wood Combustion	5.72e+02	8.86e+03	2.36e+05
Primary Aluminum Production	1.41e+02	6.62e+02	3.88e+03
Coke Ovens: Charging, Topside & Door Leaks	7.18e+01	5.39e+02	6.79e+02
Open Burning of Scrap Tires	5.25e+01	2.94e+02	
Commercial Coal Combustion	3.60e+01	1.73e+02	2.74e+03
On-Road Vehicles	3.44e+01	7.59e+01	5.62e+04
Residential Coal Combustion	3.19e+01	1.03e+02	
Coke Ovens: Pushing, Quenching & Battery Stacks	3.01e+01	5.17e+02	
Non-Road Vehicles and Equipment (NRVE) - Other	2.40e+01	4.70e+01	2.51e+04
Petroleum Refining: All Processes	1.64e+01	1.10e+03	
Pulp and Paper - Kraft Recovery Furnaces	3.74e+00	6.49e+02	
Industrial Coal Combustion	3.09e+00	1.57e+02	2.41e+03
Portland Cement Manufacture: Non-Hazardous Waste Kilns	2.60e+00	4.79e+01	
Portland Cement Manufacture: Hazardous Waste Kilns	2.08e+00	1.26e+01	
Residential Oil Combustion	1.70e+00	2.10e+01	1.47e+03
Asphalt Roofing Production	1.68e+00	4.36e+01	
Industrial Waste Oil Combustion	1.34e+00	7.82e+00	
Industrial Wood/Wood Residue Combustion	1.21e+00	6.88e+01	4.42e+04
Industrial Stationary IC Engines - Natural Gas	1.03e+00	4.76e+01	
Commercial Wood/Wood Residue Combustion	1.01e+00	3.58e+01	1.95e+03
Consumer Products Usage		5.73e+03	
Aerospace Industry (Surface Coating)		1.64e+03	
Blast Furnace and Steel Mills		4.99e+02	
Gasoline Distribution (Stage II)		3.74e+02	
Gasoline Distribution (Stage I)		3.55e+02	
Industrial Inorganic Chemicals Manufacturing		1.57e+01	
Pulp and Paper - Lime Kilns	2.50e-01	1.83e+02	
Fabricated Rubber Products		1.48e+02	
Plastic Foam Products Manufacturing		1.10e+02	
Chemical Manufacturing: Cyclic Crude and Intermediate Production		1.04e+02	
Wood Treatment/Wood Preserving		9.04e+01	
Coke Ovens: By-Product Recovery Plants		7.78e+01	
Utility Coal Combustion	2.10e-01	7.55e+00	3.86e+04
Residential Natural Gas Combustion	8.02e-02	5.10e+00	4.14e+03
Industrial Stationary IC Engines - Diesel	8.93e-02	5.02e+00	1.93e+03
Commercial Natural Gas Combustion		3.00e-02	1.92e+03
Industrial Turbines - Diesel Fired		1.55e-02	1.73e+03
Commercial Oil Combustion	3.16e-02	5.33e+01	1.32e+03
Utility Natural Gas Combustion		6.90e-01	1.00e+03
Industrial Natural Gas Combustion		2.00e-02	9.28e+02
Industrial Turbines: Natural Gas Fired		1.38e+01	7.39e+02
Total Emissions (tons/yr)	2,001.24	25,430.45	426,936.00

*Indicates total emissions from multiple SIC Codes reporting in TRIS for that source category.
Source: EPA, 1998a.

H.1.2 USES

There are presently no known commercial uses for PACs. In the past, some PACs were produced in small quantities for research purposes or used in medicines or in the production of dyes, plastics, or pesticides (ATSDR, 1996). For example, dibenz(a,h)acridine was previously used as a dye for pharmaceuticals and medical products; however, the use was abandoned due to its carcinogenic nature (ECDIN, 1997). No additional information was available from the literature on specific PACs other than benzo(a)pyrene. Currently, most, if not all, PACs are byproducts of combustion or impurities and not created for use themselves.

H.2 CURRENT TOXIC RELEASE INVENTORY (TRI) STATUS

Two individual PACs, anthracene and naphthalene, and one PAC category containing all but two (3-methylcholanthrene and fluoranthene) of the individual PACs presented in Section H.1, are currently listed on TRI. The present TRI reporting thresholds for the PAC category are 25,000 pounds for manufacturing and processing and 10,000 pounds for otherwise use. The *de minimis* concentration applicable to the PAC category is 0.1%, with the exception of benzo(a)phenanthrene and dibenzo(a,e)fluoranthene, which are subject to the 1.0% *de minimis* concentration.

Table H-2 lists the 1996 TRI reporting industries by SIC major group. A total of 136 Form R reports and 11 Form A reports were filed in 1996. A total of 1,921,882 pounds of PACs was released and reported to TRI under Section 8.1. A total of 31,080,205 pounds of PACs was reported under Section 8 (8.1-8.8), which consists of releases, energy recovery, recycling, treatment, and one-time releases. (EPA, 1998c)

TABLE H-2
SUMMARY OF TRI REPORTING FOR PAC CATEGORY, 1996

SIC Major Group	Number of Form Rs	Number of Form As
24 - Lumber and Wood Products	0	1
28 - Chemicals and Allied Products	20	1
29 - Petroleum Refining and Related Industries	53	9
30 - Rubber and Miscellaneous Plastics Products	10	0
32 - Stone, Clay, Glass, and Concrete Products	2	0
33 - Primary Metal Industries	29	0
36 - Electronic and Other Electrical Equipment and Components, Except Computer Equipment	10	0
44 - Water Transportation	1	0
No SIC Reported	11	0
Total	136	11

Source: EPA, 1998c.

Almost half of the Form R reports were from the petroleum refining and related industries (SIC 29). Other major Form R reporters include primary metal industries (SIC 33) and chemicals and allied products (SIC 20).

It should be noted that TRI does not cover some sources of PACs. Sources such as residential wood combustion, consumer product usage, and wildfires and prescribed burning, which amounted to 63% of estimated total 1990 air emissions of 16-PAH, would not be reported (EPA, 1998a). Also, TRI reporting does not cover mobile sources such as motor vehicles or rubber tire wear.

H.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS

This section presents estimates of additional facilities that may report to TRI for the group of 21 PACs and benzo(g,h,i)perylene, assuming the reporting thresholds are lowered. Four reporting threshold levels were analyzed: 1 pound, 10 pounds, 100 pounds, and 1,000 pounds. The following estimates also assume the *de minimis* exemption would be eliminated; thus reporting is expected from facilities manufacturing, processing, or otherwise using PACs or benzo(g,h,i)perylene above reporting thresholds, regardless of the concentration. Tables I-5, I-6 and I-7, presented at the end of this section, summarize the estimated additional reporting for the group of 21 PACs and benzo(g,h,i)perylene.

Due to the lack of information on the manufacture of PACs, reporting at lower thresholds was based on emission factors. The use of emission factors may underestimate the amount of PACs at a given facility. Emission factors were not available for all the PACs in the PAC category, thus the emission factor for the PAC category is the sum of the emission factors for the individual compounds that were available. For example, for Industrial Wood Waste combustion, emission factors were available (EPA, 1996) for six of the compounds in the PAC category [benzo(a)anthracene; benzo(a)pyrene; benzo(a)phenanthrene (chrysene); dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene, and benzo(k)fluoranthene] as well as for benzo(g,h,i)perylene. The emission factor for the PAC category for Industrial Wood Waste combustion was constructed as the sum of the emissions of the six PACs for which emission data was available. The actual quantity may exceed the estimate, if any of the 14 remaining PACs are also created.

H.3.1 ANALYTICAL METHODS

The following subsections provide an explanation of the process used to estimate the number of additional TRI reports by particular SIC codes at the lower thresholds. Values used throughout these calculations include:

- Density of #2 fuel oil = 7.05 lbs/gal
- Density of #6 fuel oil = 7.88 lbs/gal
- Density of crude oil = 7.3 lbs/gal

PAC concentrations:

- 4.0 ppm in crude oil (API, 1994)
- 4.475 ppm in #2 fuel oil (API, 1994)
- 570 ppm in #6 fuel oil (API, 1994)
- 5.2×10^{-4} lbs/ton in coal (EPA, 1998b)
- 8.4×10^{-4} lbs/ton in wood (EPA, 1998b)
- PAC concentrations do not include benzo(g,h,i)perlyne

Benzo(g,h,i)perylene concentrations:

- 1.8×10^{-6} ppm (estimated) in crude oil
- 0.05 ppm in #2 fuel oil (API, 1994)
- Unknown in #6 fuel oil (a review of sources used for PAC concentrations in fuels provided no concentration value for benzo(g,h,i)perylene in #6 fuel oil)
- 9.9×10^{-6} ppm in coal (EPA, 1998b)
- 7×10^{-6} lbs/ton in wood (EPA, 1998b)

Petroleum Refining (SIC Code 2911)

PACs are processed in petroleum refining operations as constituents in crude oil. A total of 44 petroleum refining facilities report on the PAC category at current thresholds (U.S. EPA 1997). To estimate the number of petroleum refineries that may submit TRI reports at the lower thresholds, the amount of crude oil that would require distillation was calculated based on the following assumptions and calculations:

- Refinery distillation capacity in the U.S. of 15.2 million barrels/day (Dept. of Energy, 1997a).
- Total amount of PACs estimated as

$$= 15.2 \times 10^6 \frac{bbl}{day} \times \frac{4\ lbs\ PAC}{10^6\ lbs\ crude} \times \frac{7.3\ lbs}{gal} \times \frac{42\ gal}{bbl} \times \frac{365\ day}{year}$$

$$= 6.8\ million\ lb/year$$

- Number of facilities with more than 10 full-time employees in SIC 2911 = 176 (EPA 1995).
- Total estimated PACs of 6.8 million lbs/year ÷ 176 facilities = 38,700 lbs/year.

Based on the calculated throughputs, all petroleum refining facilities are estimated to report PACs at the lower reporting thresholds.

Benzo(g,h,i)perylene is a minor constituent in crude oil. Due to the extremely low concentration of benzo(g,h,i)perylene in crude oil, no petroleum refineries are estimated to report for this chemical.

Combustion Sources (SIC Codes 20-39)

PACs are coincidentally manufactured as products of incomplete combustion of fossil fuels. PACs are also otherwise used as constituents of all fossil fuels, in particular wood, petroleum coke, and #6 fuel oil. Combustion of fossil fuels is expected to be the main source of reports on PACs and benzo(g,h,i)perylene in SIC codes 20-39. A detailed analysis regarding the number of facilities in SIC codes 20-39 that may submit TRI reports for the PACs category and benzo(g,h,i)perylene is provided in Appendix A. Estimates are based on the assumptions and calculations listed above and on the following:

- 22,399 facilities with more than 10 full-time employees burn oil (residual or distillate), coal or wood waste in SIC codes 20-39 that may be subject to TRI reporting requirements (Department of Energy, 1997). Since the Department of Energy database does not report wood waste combustion, EPA's Industrial Combustion Coordinated Rulemaking database was used for estimating the number of wood combustion facilities (see Appendix A).
- Facilities that use multiple fuels may have been counted multiple times (see Appendix A).

Electric Services And Combination Utilities (SIC Codes 4911, 4931, 4939)

Electric services and combination utilities burn fossil fuels and, thus, otherwise use and/or manufacture PACs or benzo(g,h,i)perylene. The number of additional facilities that may submit TRI reports at lower thresholds was estimated using the approach described in Appendix A.

Commercial Hazardous Waste Treatment (SIC Code 4953)

Commercial hazardous waste treatment facilities may manufacture or otherwise use PACs received in waste streams. To estimate the number of commercial hazardous waste treatment facilities that may report on PACs at lower reporting thresholds, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose. First, TRI data may underestimate the *number of reporting facilities* because TRI-subject hazardous waste facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the hazardous waste facility may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities, and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of hazardous waste treatment facilities at which amounts of PACs would exceed a lower reporting threshold (1, 10, 100, 1,000 lbs) were counted. Facilities exceeding current reporting thresholds were not included in this count.

The number of benzo(g,h,i)perylene reports expected under each regulatory option is assumed to be related to the number of reports for PACs since benzo(g,h,i)perylene is generated by similar processes although at different rates. The PAC category is composed of a number of individual constituents whereas benzo(g,h,i)perylene is a single PAC. Therefore, the number of benzo(g,h,i)perylene reports is expected to be lower at any reporting threshold than the number of PAC reports. To account for the expected difference in numbers of reports for benzo(g,h,i)perylene, the number of PAC reports expected under each regulatory option was weighted by the following ratio:

$$\frac{\text{benzo(g,h,i)perylene reports for all SIC codes except 4953}}{\text{PAC reports for all SIC codes except 4953}}$$

Petroleum Bulk Stations and Terminals (SIC Code 5171)

Petroleum bulk stations and bulk terminals process PACs and benzo(g,h,i)perylene as a trace constituents in crude oil, No. 2 fuel oil, and No. 6 fuel oil (EPA, 1997d). The estimated number of facilities in SIC Code 5171 expected to submit reports for PACs and benzo(g,h,i)perylene at lower reporting thresholds is based on the methodology presented in Appendix H of the industry expansion economic analysis. This methodology did not consider the extent to which facilities handle more than one product type containing the same PBT chemical and overestimates of the number of facilities expected to report for each chemical. Therefore, the methodology was enhanced to consider the overlap of multiple products handled by a single facility. Data on fuel throughput and chemical concentration by fuel type were used to estimate the unique number of facilities that will file reports for each PBT chemical. The estimate was based on a set of six model facilities described in the industry expansion economic analysis, each characterized by its throughput of petroleum products containing at least one TRI constituent above *de minimis* levels. Each model facility is assumed to represent a number of facilities with similar fuel throughput characteristics, a given subset of which are assumed to handle each of the petroleum products. The percentage of facilities handling each petroleum product was calculated using data from the Independent Liquid Terminals Association (ILTA) directory which identifies the different combination of products handled by each member facility.

The number of petroleum bulk stations and terminals expected to submit additional TRI reports for PACs and benzo(g,h,i)perylene at lower reporting thresholds (1, 10, 100, or 1,000 lbs/yr) were estimated by the following procedure:

- Using available concentration data, calculate the minimum annual throughput required to exceed each of the lower reporting thresholds for PACs and benzo(g,h,i)perylene in each petroleum product;
- For each model facility, identify the petroleum products for which annual throughput is sufficient to exceed each of the lower reporting thresholds for PACs and benzo(g,h,i)perylene;

- Estimate the percentage of facilities in the ILTA directory that handle at least one of the petroleum products with sufficient throughput to exceed lower reporting thresholds for each model facility;
- Apply the percentage developed in the previous step for each model facility to the number of facilities represented by that model facility to estimate the number facilities expected to submit a report for PACs and benzo(g,h,i)perylene; and
- Calculate the total number of facilities expected to report at each of the lower reporting thresholds by summing the number of facilities reporting for PACs and benzo(g,h,i)perylene across all six model facilities.

The amount of each chemical being processed by the petroleum bulk stations and bulk terminals and subsequently the number of facilities expected to report at the lower thresholds is based on the concentration of each chemical (presented at the beginning of this section) and the petroleum product throughputs. Annual product sales at petroleum bulk stations and terminals were 11,017,867,000 gallons of No. 6 fuel oil, 35,609,975,000 gallons of No. 2 fuel oil, and 42,245,575,000 gallons of crude oil (Department of Commerce, 1992). The amounts of each chemical through the petroleum bulk terminals was calculated as shown below.

PACs

No. 6 fuel oil: (11,017,867,000 gal/yr) × (7.88 lbs/gal) × (570 lb PACs/1x 10^6 lb oil) = 49,487,851 lbs PACs/yr

No. 2 fuel oil: (35,609,975,000 gal/yr) × (7.05 lbs/gal) × (4.475 lb PACs/1x 10^6 lb oil) = 1,233,571 lbs PACs/yr

Crude oil: (42,245,575,000 gal/yr) × (7.3 lbs/gal) × (4.0 lb PACs/1 × 10^6 lb oil) = 1,123,450 lbs PACs/yr

Benzo(g,h,i)perylene

No. 6 fuel oil: No concentration information was available, therefore no estimates were made.

No. 2 fuel oil: (35,609,975,000 gal/yr) × (7.05 lbs/gal) × (0.05 lb benzo(g,h,i)perylene/ 1x 10^6 lb oil) = 12,553 lbs benzo(g,h,i)perylene /yr

Crude oil: (42,245,575,000 gal/yr) × (7.3 lbs/gal) × (0.0000018 lb benzo(g,h,i)perylene/1 × 10^6 lb oil) = 1 lbs benzo(g,h,i)perylene/ yr

Total PAC activity for SIC code 5171:
49,487,851 lbs +1,233,571 lbs + 1,233,571 lbs = 51,844,872 lbs/yr

Total benzo(g,h,i)perylene activity for SIC code 5171:
12,553 lbs + 1 lb = 12,554 lbs/yr

To determine the number of facilities that may submit additional TRI reports for PACs, and benzo(g,h,i)perylene in SIC code 5171 at lower thresholds, the model facilities and their corresponding annual product throughput estimates, listed in the *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313* (EPA, 1997b) were used. Table H-

3, reproduced from Table H-2 (EPA, 1997b) presents the annual throughputs and number of facilities represented by the model.

TABLE H-3
ANNUAL THROUGHPUT ESTIMATES AND TOTAL NUMBER OF FACILITIES FOR SIC CODE 5171 MODEL FACILITIES

Product	Annual Throughput for Each Model Facility Size Category (1000 gallons/year)					
	1	**2**	**3**	**4**	**5**	**6**
Gasoline	3,750	5,100	34,500	85,000	170,000	340,000
No. 6 Fuel Oil	45	61	4,809	12,022	24,045	48,090
Crude Oil	371	505	17,862	44,655	89,317	178,623
No. 2 Fuel Oil/ Diesel	1,665	2,264	11,166	27,916	55,832	111,665
Lubricating Oils	156	213	176	441	883	1,767
Aviation Gas	17	24	161	404	808	1,616
Jet Fuel	45	62	2,738	6,847	13,694	27,389
Total Number of Facilities	**1,906**	**558**	**551**	**317**	**372**	**138**

Source: EPA, 1997b

Notes: No throughput is estimated for additives. Annual throughput for each product was calculated by multiplying the daily throughput by 340 days for bulk terminals and 300 days for bulk plants. Model facility throughputs for each product type were calculated separately and does not mean that each model facility handles all seven petroleum products. Estimates of the number of facilities and annual throughput for gasoline are based on "Model Plants" described in *Gasoline Distribution Industry (Stage I)- Background Information for Proposed Standards*. Office of Air Quality Planning and Standards (EPA-453/R-94-002a), January 1994. Model Facility 1 and 2 are based on Model Plant Numbers 4 and 5, respectively, in the Background Information document; and Model Facility 3,4,5, and 6 are based on Model Terminal Numbers 1,2,3, and 4.

Using the annual chemical throughputs, the amount of PACs and benzo(g,h,i)perylene processed through each model facility was determined. The number of facilities represented by each model that handle No. 6 residual fuel oil and crude oil was determined using the appropriate percentages. Table H-4 presents the results of this analysis. An example calculation of annual PAC and benzo(g,h,i)perylene throughputs for model facility 6 is shown below.

Model Facility No. 6 Annual PAC Throughputs:

No. 6 fuel oil: (48,090,000 gal/yr) × (7.88 lb/gal) × (570 lbs PACs/1 × 10^6 lbs oil) =
216,001 lbs PACs/yr

No. 2 fuel oil: (111,665,000 gal/yr) × (7.05 lb/gal) × (4.475 lbs PACs/1 × 10^6 lbs oil) =
5,216 lbs PACs/yr

Crude oil: (178,623,000 gal/yr) × (7.3 lb/gal) × (4.0 lbs PACs/1 × 10^6 lbs oil) =
3,523 lbs PACs/yr

Model Facility No. 6 Annual Benzo(g,h,i)perylene Throughputs:

No. 6 fuel oil: No calculations made.
No. 2 fuel oil: (111,665,000 gal/yr) × (7.05 lb/gal) × (0.05 lbs benzo(g,h,i)perylene/1 × 10^6 lbs oil) = 39 lbs benzo(g,h,i)perylene/ yr
Crude oil: (178,623,000 gal/yr) × (8.345 lb/gal) × (0.0000018 lbs benzo(g,h,i)perylene/1 × 10^6 lbs oil) = 0.0 lbs benzo(g,h,i)perylene/ yr

Number of Facilities Represented by Model #6 that Handle Each Product
No. 2 Fuel Oil: 55% × 138 = 76
No. 6 Fuel Oil: 32% × 138 = 44
Crude Oil: 13% × 138 = 18

TABLE H-4
ESTIMATED THROUGHPUT PER FACILITY
BASED ON MODEL FACILITIES
SIC 5171

Model				Analysis		
Model Facility Number	Number of Facilities Represented By Each Model	Fuel Type	Annual Throughput (10^3 gal/yr)	Facilities Handling Each Fuel	Estimated Throughput Per Facility (lb/yr)	
					PAC	B(g,h,i)p
1	1906	No. 6 Fuel Oil	45	610	202	NA
		No. 2 Fuel Oil	1665	1048	53	1
		Crude Oil	371	248	11	0
2	558	No. 6 Fuel Oil	61	179	274	NA
		No. 2 Fuel Oil	2264	307	71	1
		Crude Oil	505	73	15	0
3	551	No. 6 Fuel Oil	4809	176	21,600	NA
		No. 2 Fuel Oil	11166	303	352	4
		Crude Oil	17862	72	522	0
4	317	No. 6 Fuel Oil	12022	101	53,998	NA
		No. 2 Fuel Oil	27916	174	881	10
		Crude Oil	44655	41	1,304	0
5	372	No. 6 Fuel Oil	24045	119	108,001	NA
		No. 2 Fuel Oil	55832	205	1,761	20
		Crude Oil	89317	48	2,608	0
6	138	No. 6 Fuel Oil	48090	44	216,001	NA
		No. 2 Fuel Oil	111665	76	3,523	39
		Crude Oil	178623	18	5,216	0

B(g,h,i)p = Benzo(g,h,i)perylene
NA=Not applicable; due to lack of concentration data, no estimates were made.

For model facility 6, the throughput of each of the three petroleum products identified above would trigger reporting for PACs. The ILTA Directory indicates that 188 of the 311 facilities surveyed process at least one of the three products. The unique number of model 6 facilities expected to submit additional TRI reports for PACs at each of the lower thresholds is (188 ÷ 311) x 138 = 83 facilities.

At a reporting threshold of 1 or 10 pounds per year, only the processing of No. 2 fuel oil at model 6 facilities would trigger reporting for benzo(g,h,i)perylene. The ILTA Directory indicates that 171 of the 311 facilities surveyed process No. 2 fuel oil. The unique number of model 6 facilities expected to submit additional TRI reports for benzo(g,h,i)perylene at the 1 or 10 pound reporting threshold is (171 ÷ 311) x 138 = 76 facilities.

Model 6 facilities do not have sufficient throughput of any of the three petroleum products containing benzo(g,h,i)perylene to require reporting at the 100 or 1,000 pound reporting thresholds.

Solvent Recovery Services (SIC Code 7389)

PACs may be received in waste streams of solvent recovery services (SIC 7389). To estimate the number of solvent recyclers that may report on PACs at lower reporting thresholds, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose. First, TRI data may underestimate the *number of reporting facilities* because TRI- subject hazardous waste facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the solvent recycler may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities, and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of solvent recyclers at which amounts of PACs would exceed a lower reporting threshold (1, 10, 100, 1,000 lbs) were counted. Facilities exceeding current reporting thresholds were not included in this count.

Summary

Industries manufacturing, processing, or otherwise using PACs and benzo(g,h,i)perylene that may submit TRI reports at the lower thresholds are presented in Tables I-5 and I-6, respectively. An estimate of the number of facilities currently reporting to TRI for PACs is also provided.

TABLE H-5
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR POLYCYCLIC AROMATIC COMPOUNDS

SIC Code	Industry Sector	Total Number of Facilities with 10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
20 - 39	Combustion Sources Only	22,399	0	15,449	10,036	4,631	1,702
49	Electric Utilities (SIC Code 4911)	Coal: 606 Oil: 236	0	Coal: 390 Oil: 124	Coal: 387 Oil: 122	Coal: 361 Oil: 104	Coal: 250 Oil: 86
	Electric Utilities (SIC Code 4931)			Coal: 197 Oil: 98	Coal: 196 Oil: 96	Coal: 183 Oil: 82	Coal: 126 Oil: 68
	Electric Utilities (SIC Code 4939)			Coal: 19 Oil: 14	Coal: 19 Oil: 14	Coal: 18 Oil: 11	Coal: 12 Oil: 10
4953	Commercial Hazardous Waste Treatment	162	0	14	10	10	8
2911	Petroleum Refining	176	44	132	132	132	132
5171	Petroleum Bulk Stations & Terminals	3,842	0	2,323[b]	2,323[b]	1,634[b]	823[b]
7389	Solvent Recovery Services	191	0	2	2	0	0
	TOTAL FOR ALL FACILITIES	**27,612**	**44**	**18,762**	**13,337**	**7,166**	**3,217**

[a] There were 137 TRI reports for PACs submitted for 1995. It is not known how many were for fuel combustion and how many were for process use. The reports at current thresholds for electric utilities are estimated based on fuel throughputs and typical PAC concentration levels.

[b] Total number of facilities may differ from those presented in Table H-4 due to rounding of the percent of facilities handling each fuel type.

TABLE H-6
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR BENZO(G,H,I)PERYLENE

SIC Code	Industry Sector	Total Number of Facilities with 10 Employees	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
20 - 39	Combustion Sources Only	22,399	NA	3,163	285	15	0
49	Electric Utilities (SIC Code 4911)	Coal: 606 Oil: 236	Coal: NA Oil: NA	Coal: 363 Oil: 0	Coal: 220 Oil: 0	Coal: 4 Oil: 0	Coal: 0 Oil: 0
	Electric Utilities (SIC Code 4931)		Coal: NA Oil: NA	Coal: 183 Oil: 0	Coal: 111 Oil: 0	Coal: 2 Oil: 0	Coal: 0 Oil: 0
	Electric Utilities (SIC Code 4939)		Coal: NA Oil: NA	Coal: 18 Oil: 0	Coal: 11 Oil: 0	Coal: 0 Oil: 0	Coal: 0 Oil: 0
4953	Commercial Hazardous Waste Treatment	162	NA	2	1	0	0
2911	Petroleum Refining	176	NA	0	0	0	0
5171	Petroleum Bulk Stations & Terminals	3,842	NA	758	281	0	0
	TOTAL FOR ALL FACILITIES	**27,421**	**NA**	**4,487**	**909**	**21**	**0**

H.3.4 CONCLUSIONS

As a result of lowering the TRI reporting thresholds, a summary of the additional reports that may be expected from PACs and benzo(g,h,i)perylene are presented in Table H-7.

TABLE H-7
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR POLYCYCLIC AROMATIC COMPOUNDS (PACS) AND BENZO(G,H,I)PERYLENE

Threshold	PAC	Benzo(g,h,i)perylene
1 lb/yr	18,762	4,487
10 lbs/yr	13,337	909
100 lbs/yr	7,166	21
1,000 lbs/yr	3,217	0

LITERATURE CITED

1. American Petroleum Institute (1994). Transport and Fate of non-BTEX Petroleum Chemicals in Soil and Groundwater. Prepared by Arthur D. Little, Inc. Cambridge, Massachusetts.

2. Agency for Toxic Substances and Disease Registry (1990). Public Health Statement: Creosote. http://atsdr1.atsdr.cdc.gov:8080/ToxProfiles/phs9009.html. Downloaded December 3, 1997

3. Agency for Toxic Substances and Disease Registry (1996). ToxFAQs: Polycyclic Aromatic Hydrocarbons. http://atsdr1.atsdr.cdc.gov:8080/tfacts69.html. Downloaded December 3, 1997

4. California Environmental Protection Agency (1993). Benzo(a)pyrene as a Toxic Air Contaminant. Draft SRP Version. CalEPA, Air Resources Board.

5. ECDIN (ND). Dibenz(a,h)acridine 226368. http://ulisse.etoit.eudra.org/cgibin_ecd/subquery _name. Downloaded December 12, 1997.

6. Environment Canada (1994). Canadian Environmental Protection Act: PAH Emissions into the Canadian Environment 1990-PSL Supporting Document No. 1.

7. Kowalczyk, G., Grant, L.B., Ricci, P.F. (1985). Air Emission Risk Assessment Model: Benzo(a)pyrene and Arsenic Emissions from the Mt. Tom Power Plant. Presented at the 78th Annual Meeting of the Air Pollution Control Association, Detroit, Michigan, June.

8. National Institute of Health (ND). Arc Anticipated Carcinogens: Polycyclic Aromatic Hydrocarbons. http://ntp-ob.niehs.nih.gov/htdocs/ARC/ARC_RAC/PAH/html. Downloaded January 28, 1998.

9. New Jersey Department of Health (1989). Hazardous Substance Fact Sheet: Benzo(a)pyrene.

10. Pacific Gas and Electric Company, Southern California Edison, and Southern California Gas Company (1987). Potential Health Risks from Former Manufactured-Gas Plant Sites: Toxicity and Chemical Property Profiles. Prepared by ENVIRON Corporation.

11. Pancirov and Brown (1975).

12. Rondia, D., Cooke, M., and Haroz, R.K. (1983). Mobile Source Emissions Including Polycyclic Organic Species. D. Reidel Publishing Company. Dordrecht/Boston/Lancaster. [Cited in CalEPA, 1993.]

13. Spectrum Laboratories (ND). Chemical Fact Sheets. http://www.speclab.com/compound. Downloaded December 30, 1997.

14. U.S. Department of Commerce (1992). 1992 Census of Wholesales: Misc Subject. Bureau of the Census.

15. U.S. Department of Commerce (1995). 1995 County Business Patterns. Bureau of the Census. CPB/95-1.

16. U.S. Department of Energy (1997). Manufacturing Consumption of Energy 1994. DOE/EIA-0512(94). December.

17. U.S. Department of Energy (1997a). Petroleum Supply Annual 1996. DOE/EIA-0340 (96)/1. June.

18. U.S. Department of the Interior (1987). Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. DOI, Fish and Wildlife Service. Contaminant Hazard Reviews, Biological Report 85(1.11).

19. U.S. EPA (1978). Environmental Pathways of Selected Chemicals in Freshwater Systems: Part II. EPA-600/7-78-074. Prepared by SRI International. Menlo Park, California.

20. U.S. EPA (1994). Regulatory Impact Analysis of the Final Rule to Add Various Chemicals and Chemical Categories to the EPCRA Section 313 List of Toxic Chemicals. U.S. EPA, Regulatory Impacts Branch, Economics, Exposure and Technology Division. Office of Pollution Prevention and Toxics.

21. U.S. EPA (1995). Profile of Petroleum Refining Industry. Office of Enforcement and Compliance Assurance. EPA 310-R-95-013.

22. U.S. EPA (1996). AP-42. Compilation of Air Pollutant Emission Factors. Office of Air Quality Planning and Standards. February.

23. U.S. EPA (1997). 1995 Toxics Release Inventory (TRI) Database.

24. U.S. EPA (1997a). 1990 Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)/ 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead (1997a). U.S. EPA, Emissions, Monitoring and Analysis Division, Emissions Factor and Inventory Group and Air Quality Strategies and Standards Division, Visibility and Ecosystem Protection Group.

25. U.S. EPA (1997b). Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313. Regulatory Impacts Branch, Economics, Exposure and Technology Division, Office of Pollution Prevention and Toxics.

26. U.S. EPA (1998a). Source Category Listing for Section 112(d)2 Rulemaking Pursuant to Section 112(c)6 Requirements; 1990 Emissions Inventory of Section 112(c)6 Pollutants (1998). Federal Register, Vol#63, No 69, page 17838. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

27. U.S. EPA (1998b). Locating and Estimating (L&E) Air Toxic Emissions from Sources of Polycyclic Organic Material. Office of Air Quality and Standards. EPA-454/R-98-014. July.

28. U.S. EPA (1998c). 1996 Toxics Release Inventory.

APPENDIX I
POLYCHLORINATED BIPHENYLS

I.1 CHEMICAL PROFILE

Polychlorinated Biphenyls (PCBs) are a group of 209 synthetic halogenated aromatic hydrocarbons that were commercially used and sold as a mixture of isomers. PCBs may be either oily liquids or solids, with a color ranging from colorless to light yellow (ASTDR, 1997). More than 200 types of chlorination of the biphenyl molecule are possible; however, only about 100 individual isomers are likely to occur at significant concentrations in commercial PCB mixtures (EPA, 1998a).

I.1.1 PRODUCTION

Polychlorinated biphenyls (CAS 1336-36-3), otherwise known as PCBs, were first created in 1881, and commercial manufacture began in 1929. Since the 1930s, PCBs were used in products such as heat transfer agents, lubricants, dielectric agents, flame retardants, plasticizers, and waterproofing materials (Eisler, 1986). In the U.S., more than 1.25 billion pounds of PCBs were produced from 1930 to 1975. Domestic production of PCBs was banned in 1976 under the Toxic Substances Control Act (TSCA). Furthermore, in 1977, the U.S. Environmental Protection Agency (EPA) initiated a PCB destruction and disposal program with mandatory PCB electrical equipment phase-out programs.

From 1930 to 1975, two grades of PCB mixtures were produced and sold: a purified grade and a less pure, darker grade (EPA, 1987). PCBs were commercially produced by the chlorination of a biphenyl with anhydrous chlorine using iron filings or ferric chloride as a catalyst. The primary U.S. producer was Monsanto Industrial Chemicals Company, which sold PCBs under the trade names “Aroclor” and “Askarel.” Other PCB commercial trade names included Chlorextol, Dykanol, Inerteen, No-Famol, Pyranol, Kennechlor, Chlorphen, Fenclor, and Phenoclor (EPA, 1997; Eisler, 1986).

I.1.2 USES

Prior to 1976, PCBs were mostly used as a dielectric fluid in electrical equipment (e.g., transformers and capacitors). PCBs were used in high-voltage power capacitors for power factor correction in the distribution of electric power; in low-voltage power capacitors to improve the efficiency of lighting systems; and in small industrial capacitors for power factor improvement in equipment such as air conditioners, pumps, and fans. Additional PCB uses included hydraulic fluids and lubricants, plasticizers (a material incorporated into plastic to increase its workability and flexibility), heat transfer fluids (materials that absorb thermal energy from a source and deliver heat to a place of utilization), and investment castings (used as a filler for investment casting wax to decrease shrinkage of the ceramic mold). PCBs were also used as laminates in adhesive formulations involving polyurethanes and polycarbonates to prepare safety and acoustical glasses.

PCBs have also been used in adhesive formulas in metals and ceramics to improve toughness and resistance to oxidative and thermal degradation during lamination. Due to PCBs' ability to resist photochemical degradation, oxidation, and fires, they were used as textile coating mixtures for ironing board covers and waterproof canvas (EPA, 1998a; EPA, 1987). Other PCB uses include the following:

- Paints
- Varnishes
- Electrical coatings
- Insulating tapes
- Protective lacquers
- Epoxy resins
- Sealing and caulking solutions
- Pressure-sensitive record and colored copying papers
- Floor tiles
- Brake linings
- Petroleum additives
- Soil erosion retardants
- Insecticides
- Bactericides
- Metal quenchers
- Gasket sealers
- Synthetic rubber
- Automobile body sealants
- Asphalt
- Plastic decorative articles
- Lubricants in natural gas pipeline compressors

Table I-1 summarizes the industrial uses of PCBs between 1929 and 1975 (EPA, 1997d). Closed electrical systems (e.g., capacitors and transformers) accounted for approximately 77% of industrial uses. Open-ended applications (e.g., plasticizers, carbonless copy paper, petroleum additives, and others) accounted for 15% of industrial uses. Finally, nominally closed systems (e.g., heat transfer fluids, hydraulic fluids, and lubricants) accounted for an additional 8% of industrial uses (EPA, 1997d; EPA, 1987).

In 1976, PCB domestic production was banned under TSCA. In 1977, EPA initiated a PCB destruction and disposal program. In 1979, the PCB Ban Rule was issued requiring all non-totally enclosed PCB activity to be authorized by EPA. Examples of EPA-authorized activities included: servicing PCB transformers and PCB-contaminated transformers; use in and servicing of railroad transformers and mine equipment; use in heat transfer systems, hydraulic systems, and natural gas pipeline compressors; servicing electromagnets; small quantities for research and development; and microscopy mounting medium (EPA, 1987). In addition, the following uses of PCBs were eliminated: PCB transformers at food and feed facilities in 1985; PCB-containing transformers of 480 volts and above in 1990; and PCB transformers below 480 volts in 1993.

Despite the ban, more than 180.4 million pounds of PCBs were estimated to be in water, sediments, disposal sites, transformers, and other containers in 1986 (Eisler, 1986).

TABLE I-1
INDUSTRIAL USES OF PCBS (1929-1975)

PCB Use	Pounds (millions)	Percent of Total
Capacitors	630	50.3%
Transformers	335	26.7%
Plasticizer uses	115	9.2%
Hydraulics and lubricants	80	6.4%
Carbonless copy paper	45	3.6%
Heat transfer fluids	20	1.6%
Petroleum additives	1	0.1%
Miscellaneous industrial uses	27	2.2%
Total	**1,253**	**100.0%**

Source: EPA, 1997d.

In 1994, U.S. commercial storage and disposal facility reports estimated that approximately 54.9 million pounds of PCB waste were in storage. Table I-2 presents the type and amount of PCBs in storage waiting for disposal in the United States during 1990 and 1994 (EPA, 1997d). As shown in Table I-2, most PCB waste in storage is bulk and PCB containers.

TABLE I-2
AMOUNT OF PCBS IN STORAGE FOR DISPOSAL IN THE UNITED STATES

Type	1990 (thousands of lbs)	1994 (thousands of lbs)
Large capacitors	7,747	4,608
Article containers	2,366	2,233
Transformers	8,580	6,413
Bulk	28,735	20,186
PCB containers	35,708	21,422
Total	**83,136**	**54,862**

Source: EPA, 1997d.
Wastes include varying concentrations of PCB's (generally above 50 ppm) and may include the weight of transformers or capacitors, containers and other contaminated materials.

I.1.3 RELEASES

Even though PCBs are no longer produced in the U.S., PCBs may be released from the following sources: 1) incineration of PCB-contaminated waste; 2) releases to air from the redistribution of PCBs in soil and water; 3) releases from disposal sites containing transformers, capacitors, and other PCB-contaminated waste; 4) the improper disposal of other PCB-contaminated materials (e.g., residues and debris from the shredding of automobiles, appliances, building demolition wastes, and fluorescent light ballasts); and 5) the combustion of residual fuel oil (EPA, 1998a; EPA, 1997f). PCB emission sources and the estimated amounts of PCBs emitted to air in 1990 are presented in Table I-3. Of the listed source categories, the ones most likely to report to TRI under the final rule are hazardous waste incineration and residual oil combustion (utility and industrial).

PCB waste is presently required to be disposed in TSCA-approved chemical waste landfills (EPA, 1995a). The recently finalized PCB disposal rule will allow bulk waste to be disposed in RCRA Subtitle C landfills if the PCB concentration is less than 500 ppm. Table I-4 presents the distribution of PCB-contaminated waste treated by incineration or disposed in landfills in 1990 and in 1994 (EPA, 1997d). Table I-4 illustrates that most treated waste is categorized as "bulk waste," which consists of oil, soil, and remediation material.

In the early 1980s, EPA found that some synthetic organic chemicals (i.e., dyes and pigments) inadvertently generate PCBs during manufacturing. EPA subsequently issued regulations under TSCA (40 CFR 761.3) that banned the sale of any products containing an annual average PCB concentration of 25 mg/kg (50-mg/kg maximum concentration at any time). In addition, EPA required manufacturers and importers of products that inadvertently generate PCBs to report to EPA any process or import that produces or contains PCB concentrations greater than 2 mg/kg (EPA, 1996).

TABLE I-3
ESTIMATED 1990 U.S. PCB EMISSIONS TO AIR

Source Category	Number of Facilities	National Annual Activity Level	Total National Emissions (lb/yr)	Percent (%)
Municipal Waste Combustion	158	32.0×10^6 tons waste incinerated	161	51
Medical Waste Incineration	3,400	1.73×10^6 tons waste incinerated	80.5	26
Hazardous Waste Incineration	150	2.78×10^4 tons of PCBs incinerated	55.5	18
Sewage Sludge Incineration	174	953,200 tons dry sludge incinerated	10.3	3
Other Biological Incineration	1,700	117,900 tons waste incinerated	5.0	1.2
Scrap Tire Incineration	18	551,000 tons tires incinerated	2.1	0.7
Utility Residual Fuel Oil Combustion	236	181×10^6 barrels residual fuel oil consumed (3.04×10^5 lbs of PCBs burned)	0.3	0.1
Industrial Residual Fuel Oil Combustion	2,241	66×10^6 barrels residual fuel oil consumed (1.1×10^5 lbs of PCBs burned)	0.1	<0.01
TOTAL			**314.8**	**100%**

Source: EPA, 1997c. The 1990 National Emissions Inventory reported the total waste amount (PCBs and PCB-contaminated waste) as the annual activity levels for several source subcategories. The actual PCB activity levels may be significantly less.

TABLE I-4
U.S. PCB CONTAMINATED WASTE DISPOSAL AMOUNTS
(DISPOSAL IN LANDFILLS OR DESTRUCTIVE INCINERATION)

Waste Category	1990 (thousands of lbs)	1994 (thousands of lbs)
Large capacitors	20,203	8,117
Article containers	6,565	9,195
Transformers	47,800	27,601
Bulk	1,187,061	1,736,127
PCB containers	88,875	76,538
Total	**1,350,504**	**1,857,578**

Source: EPA, 1997d.
Wastes include varying concentrations of PCB's (generally above 50 ppm) and may include the weight of transformers or capacitors, containers and other contaminated materials.

I.2 CURRENT TOXIC RELEASE INVENTORY (TRI) STATUS

PCBs are currently listed on the Toxic Release Inventory (TRI). Table I-5 presents a summary of 1996 TRI reporting for PCBs. A total of 13,475 pounds of released PCBs was reported in Section 8.1. A total of 363,939 pounds of PCBs was reported under Section 8 (8.1-8.8), which consists of releases, energy recovery, recycling, treatment, and one-time releases (EPA, 1998c).

TABLE I-5
SUMMARY OF TRI REPORTING FOR PCBS, 1996

SIC Code	Number of Form Rs	Number of Form As
28: Chemical and Allied Products	1	0
30: Rubber and Miscellaneous Plastics Products	1	1
33: Primary Metal Industries	3	0
Total	**5**	**1**

Source: EPA, 1998c.

I.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS

This section presents estimates of additional TRI reporting for PCBs at the lower reporting thresholds of: 1 pound; 10 pounds; 100 pounds; and 1,000 pounds. The estimates also assume that the *de minimis* exemption would be eliminated; thus TRI reporting is expected from facilities manufacturing, processing, or otherwise using PCBs above the lower threshold, regardless of the concentration.

I.3.1 ANALYTICAL METHODS

Most PCB uses are now banned by EPA. Additional TRI reporting resulting from the lower thresholds is expected to be primarily from otherwise use of PCBs in oil and dielectric fluid, unintentional PCB manufacture or import, and disposal or combustion of PCBs. The following subsections describe the procedures used to estimate the number of facilities required to submit additional TRI reports by SIC code at the lower reporting thresholds.

PCB Electrical Equipment Uses (SIC Codes 20-39)

Closed electrical systems (e.g., capacitors and transformers) accounted for 77% of industrial uses between 1929 and 1975. Presently, intact electrical equipment (e.g., transformers, voltage regulators, capacitors, electromagnets, switches, circuit breakers, reclosers, and cable) with less than 50 ppm PCBs can be used without use restrictions, including servicing and rebuilding. Transformers containing 500 ppm or greater PCBs may be used under many restrictions and conditions. Small PCB capacitors (i.e., with less than 3 pounds of dielectric fluid, and commonly containing between 0.1 and 0.6 pounds PCBs) are widely used in fluorescent light ballasts, household appliances, and industrial equipment. Drained PCB fluids with 2 to 50 ppm from heat transfer or hydraulic systems can only be burned for energy recovery according to restrictions on burning used oils. This is required so that the PCBs do not volatilize and potentially create additional toxic products, such as PCDFs (EPA, 1997d).

The number of additional reports from manufacturing facilities with high-voltage electrical equipment was estimated based on the number of facilities expected to trigger TRI reporting requirements by refilling transformers and capacitors with PCB-contaminated fluids. These facilities otherwise use PCBs in these electrical equipment applications.

Based on a study of the electric utility industry, 0.3 percent of electric utility customers receive high-voltage power (EPA, 1998a). High-voltage customers typically use transformers, capacitors, and other equipment necessary to transform the voltages and distribute electricity to various manufacturing and facility operations (EPA, 1998a). An estimated 85% of the high-voltage customers own their own high-voltage transformation equipment. Table I-6 lists the total number of facilities in SIC codes 20-39 and the number of facilities expected to have electrical equipment containing PCBs.

Using the ratio of facilities with high-voltage electrical equipment (column B) to the total number of facilities (column A) allowed for the calculation of the total number of facilities expected to have PCB-contaminated electrical equipment and greater than 10 employees (U.S. Department of Commerce, 1995). Less than 1 percent of all facilities in SIC codes 20-39 are expected to open PCB-containing electrical equipment on-site (e.g., servicing or refilling) in any given year (ERG, 1998). Therefore, the estimated number of facilities that may report for PCBs in a given year is calculated as 1 percent of the number of facilities expected to have PCB-contaminated electrical equipment on site and more than 10 employees. An example calculation is shown below:

Textile Mill Products (SIC Code 22):

1. SIC-specific ratio (C) = 136 facilities with H-V equipment (B) / 6,349 total facilities (A) = 0.0214

2. Total number of facilities with H-V equipment and $\geq$ 10 employees = 3,971 facilities with $\geq$10 employees (D) $\times$ 0.0214 = 85

3. Estimated number of facilities reporting to TRI (F) = 85 facilities with H-V equipment × 0.01 = 1

The estimated number of facilities that may report to TRI for this activity was used in estimating the number of additional reports at lower thresholds. It was assumed that the concentration of PCBs in electrical equipment oil was less than 1,000 ppm.

Manufacturing facilities in SIC codes 20 through 39 may have transformers, electromagnets, switches, voltage regulators, and capacitors still in service that contain PCBs. Nearly all (99%) manufacturing facilities remove and dispose of this equipment in its entirety following active life rather than servicing and retrofilling with non-PCB containing dielectric fluid (ERG, 1998). Since this equipment, including the original PCB containing dielectric fluid, is disposed in its entirety, the article exemption is applicable and TRI reporting would not be expected (EPA, 1998a).

TABLE I-6
ESTIMATED NUMBER OF NON-UTILITY FACILITIES WITH PCB ELECTRICAL EQUIPMENT

SIC Codes	Number of facilities (A)	With H-V Equipment (B)	SIC-Specific Ratio (C)	Number of Facilities with ≥10 Employees (D)	Total Facilities with H-V Equipment (E)	Total Amount of PCBs (lbs/yr)	PCBs per Facility (lbs/yr)	Number of Facilities with Reportable Activity (F)
22: Textile Mill Products	6,349	136	0.021	3,971	85	>10,000[a]	>118	1
26: Paper and Allied Products	6,467	139	0.021	5,513	111	>0[d]	>0	1
28: Chemicals and Allied Products	12,197	262	0.021	7,012	151	>10,000[a]	>66	2
29: Petroleum Refining and Related Industries	2,061	44	0.021	942	20	>10,000[a]	>57	0
30: Rubber and Misc. Plastics Products	16,329	350	0.021	11,059	237	>10,000[a]	>42	2
32: Stone, Clay, Glass, and Concrete Products	16,107	345	0.021	8,296	178	>27,271	>153	2
33: Primary Metal Industries	6,674	143	0.021	4,682	100	>51,551	>516	1
34: Fabricated Metal Products	36,213	776	0.021	20,862	447	>10,000[a]	>22	4
36: Electronic and Other Electrical Equipment	17,092	366	0.021	10,064	216	>606,888	>2,810	2

Sources: Department of Commerce, 1995; EPA, 1998a; and ERG, 1998.
a - The minimum PCB amount is the current TRI reporting threshold for otherwise used.

Unintentional PCB Manufacture or Import (SIC Code 28)

Unintentional manufacturers and importers of PCBs are required under Section 6 of TSCA to notify EPA of their activity annually. During 1994 to 1998, an average of three facilities per year in SIC code 28 reported unintentional importing or manufacturing PCBs in pigments at <25 ppm. No more than 30 lbs/yr of PCBs were reported in any year (EPA, 1997g).

PCB Processing (SIC Codes 26 and 29)

PCBs may also be processed by facilities in SIC Code 29, Petroleum Refining and related Industries. PCBs were used in the past to manufacture hydraulic fluids, lubricants, etc. (SIC Code 2992). Presently, used oil can be reused in electrical equipment as a dielectric fluid, if originally a dielectric fluid; or in heat transfer and hydraulic systems, if originally such a fluid (EPA, 1997d). In asphalt roofing material products, no detectable PCB concentrations can leave the processing site. The amount of Aroclor PCBs in water discharged from an asphalt roofing processing site must be <3 µg/L (~3 ppb). PCBs in hydraulic and heat transfer systems must be less than 50 ppm (EPA, 1997e). There are 176 petroleum refining facilities potentially subject to TRI reporting requirements (EPA, 1995).

In addition to otherwise use of PCBs in electrical equipment, facilities in SIC Code 26, Paper and Allied Products, may process PCBs. Carbonless copy paper containing approximately 3.4% by weight PCBs was produced in the 1960s and early 1970s. PCBs were also introduced into the waste paper recycle stream through recycle of carbonless copy paper. Even though recent effluent data from a number of Wisconsin secondary fiber de-ink mills showed nondetect levels for PCBs, low levels of PCBs may still be detected in some recycled paper samples. PCB concentration in paper products leaving a processing site or imported into the U.S. must have an annual average of less than 25 ppm and must not exceed 50 ppm maximum at any time (EPA, 1997c). Direct wastewater discharges to surface water (does not apply to discharging into treatment works) from paper processing must be less than 3 µg/L (~3 ppb) or comply with equivalent mass-based limitations (EPA, 1997e).

Combustion Sources (SIC Codes 20-39)

PCBs may be present in approximately 10 percent of the residual oil burned by manufacturing facilities in SIC codes 20-39 and electric utilities (SIC codes 4911, 4931, and 4939) at concentrations less than 50 ppm (Martig, 1998). The total number of combustion sources potentially subject to TRI reporting requirements is 2,177 (DOE, 1997; Dept. of Commerce, 1995). A detailed analysis regarding the combustion of PCBs in manufacturing and utility boilers is provided in Appendix A.

Electric, Gas, and Sanitary Services (SIC Code 49)

The number of facilities potentially subject to TRI reporting requirements in the utilities sector include (EPA 1997a):

- Electric Services (SIC Code 4911) = 124
- Electric and Other Services (SIC Code 4931) = 98
- Combined Utilities (SIC Code 4939) = 14

Combustion criteria for incineration of PCBs in the United States includes combustion efficiency of at least 99.9% for carbon monoxide for liquid PCBs. For nonliquid PCBs, mass air emissions from the incinerator must be no greater than 0.001 g PCB/kg of the PCB introduced into the incinerator (EPA, 1997d). A detailed analysis regarding the combustion of PCBs in SIC Code 49 is provided in Appendix A.

Commercial Hazardous Waste Treatment (SIC Code 4953)

To estimate the number of facilities that may report on PCBs at lower reporting thresholds in SIC Code 4953 (Commercial Hazardous Waste Treatment), information on the disposition of PCB-contaminated items and materials at commercial hazardous waste treatment facilities was obtained from annual reports required under TSCA (40 CFR 761.180). To account for the fact that the total pounds reported per facility includes the weight of the material contaminated with PCBs (e.g. soil) or the vessel containing the PCBs, total pounds disposed was multiplied by 500 ppm. It was then possible to count the number of hazardous waste treatment facilities for which amounts of PCBs would exceed lower reporting thresholds (1, 10, 100, 1,000 lbs) (Abt Associates, 1998). The number of facilities potentially subject to TRI reporting was assumed to be the total number of commercial permitted PCB disposal companies as listed on EPA's website (EPA, 1998b). This list was supplemented with the 14 RCRA Subtitle C landfills that will be eligible to receive PCB-contaminated waste at less than 500 ppm under the recently finalized PCB Disposal Amendments (Sect. 761.61) (U.S. EPA, 1998a). Facilities estimated to exceed current reporting thresholds were not included in this count.

Petroleum Bulk Stations and Terminals (SIC Code 5171)

Petroleum bulk stations and bulk terminals may process PCBs as a trace constituent in No. 6 fuel oil (EPA, 1997d). The estimated number of facilities in SIC Code 5171 expected to submit reports for PCBs at lower reporting thresholds is based on the methodology presented in Appendix H of the *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313* (EPA, 1997a). This methodology does not consider extent to which facilities handle more than one product type containing the same PBT chemical and overestimates of the number of facilities expected to report for each chemical. Therefore, the methodology was enhanced to consider the overlap of multiple products handled by a single facility. Data on fuel throughput and chemical concentration by fuel type were used to estimate the unique number of facilities that will file reports for each PBT chemical. The estimate was based on a set of six model facilities described in the industry expansion economic analysis, each characterized by its

throughput of petroleum products containing at least one TRI constituent above *de minimis* levels. Each model facility is assumed to represent a number of facilities with similar fuel throughput characteristics, a given subset of which are assumed to handle each of the petroleum products. The percentage of facilities handling each petroleum product was calculated using data from the Independent Liquid Terminals Association (ILTA) directory which identifies the different combination of products handled by each member facility.

The number of petroleum bulk stations and terminals that may submit additional TRI reports for PCBs at lower reporting thresholds (1-, 10-, 100-, or 1,000-lbs/yr) were estimated by the following procedure:

- Using available concentration data, calculate the minimum annual throughput required to exceed each of the lower reporting thresholds for PCBs in residual oil;
- Estimate the percentage of facilities in the ILTA directory that handle residual fuel oil;
- Apply the percentage of facilities handling residual fuel oil to the number of facilities represented by each model to estimate the number of facilities expected to submit a report for PCBs at each of the lower reporting thresholds; and
- Calculate the total number of facilities that may submit additional TRI reports by summing across each model facility at the 1-, 10-, 100-, and 1,000-lbs/yr thresholds.

Petroleum bulk stations and bulk terminals process PCBs as a trace constituent in No. 6 residual fuel oil. The maximum PCBs concentration in No. 6 oil is 50 ppm (EPA, 1997d). Annual product sales at petroleum bulk stations and terminals are 11,017,867,000 gallons of No. 6 fuel oil (Department of Commerce, 1992). It is assumed that approximately 10 percent of No. 6 fuel oil is contaminated (Radian, 1993). The quantity of PCBs processed through these facilities total 440,715 pounds per year and was calculated as shown below. The density for No. 6 fuel oil was assumed to be 7.88 pounds per gallon.

No. 6 fuel oil: (11,017,867,000 gal/yr × 10%) × (7.88 lb/gal oil) × (50 lb PCBs/ 1×10^6 lb oil)
= 434,104 lbs PCBs/yr

To determine the number of facilities that may submit additional TRI reports for PCBs at the 1-, 10-, 100-, and 1,000-lbs/yr thresholds, the model facilities, and 10 percent of their corresponding annual product throughput estimates, listed in the *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313* (EPA, 1997a) was used. Table I-7 reproduces Table H-2 of the *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313* (EPA, 1997a), which presents the annual throughputs and number of facilities represented by the model.

TABLE I-7
ANNUAL THROUGHPUT ESTIMATED AND TOTAL NUMBER OF FACILITIES FOR SIC CODE 5171 MODEL FACILITIES

Product	Annual Throughput for Each Model Facility Size Category (1000 gallons/year)					
	1	**2**	**3**	**4**	**5**	**6**
Gasoline	3,750	5,100	34,500	85,000	170,000	340,000
No. 6 Fuel Oil	45	61	4,809	12,022	24,045	48,090
Crude Oil	371	505	17,862	44,655	89,317	178,623
No. 2 Fuel Oil/Diesel	1,665	2,264	11,166	27,916	55,832	111,665
Lubricating Oils	156	213	176	441	883	1,767
Aviation Gas	17	24	161	404	808	1,616
Jet Fuel	45	62	2,738	6,847	13,694	27,389
Total Number of Facilities	**1,906**	**558**	**551**	**317**	**372**	**138**

Source: EPA, 1997a

Notes: No throughput is estimated for additives. Annual throughput for each product was calculated by multiplying the daily throughput by 340 days for bulk terminals and 300 days for bulk plants. Model facility throughputs for each product type were calculated separately and does not mean that each model facility handles all seven petroleum products. Estimates of the number of facilities and annual throughput for gasoline are based on "Model Plants" describe in U.S. EPA. Gasoline Distribution Industry (Stage I) - Background Information for Proposed Standards. Office of Air Quality Planning and Standards (EPA-453/R-94-002a), January 1994. Model Facility 1 and 2 are based on Model Plant Numbers 4 and 5, respectively, in the Background Information document; and Model Facility 3, 4, 5, and 6 are based on Model Terminal Numbers 1, 2, 3, and 4. Ten percent of annual fuel throughputs are assumed to be contaminated with PCBs at a maximum concentration of 50 ppm.

Using 10 percent of the annual throughputs above, the amount of PCBs processed through each model facility was determined. Table I-8 presents the results for this analysis and a sample calculation using Model Facility No. 6 is shown below.

Model Facility No. 6 Annual PCBs Throughputs:
No. 6 fuel oil: (48,090,000 gal oil/yr × 10 percent) × (7.88 lb oil/gal oil) × (50 lbs PCB/ $1x10^6$ lb oil)= 1,895 lbs PCB/yr

Number of Facilities Represented by Model #6 that Handle No. 6 Fuel oil
No. 6 Fuel Oil: 32% × 138 = 44

For Model Facility 6, PCB quantities in No. 6 fuel oil exceed all four thresholds; 1-, 10-, 100-, and 1,000-lb/yr thresholds, and therefore 44 bulk terminals and plants may submit additional TRI reports for PCBs at all four thresholds.

Based on the analysis of the model facility, ranges for the number of facilities expected to submit additional TRI reports at 1, 10, 100, and 1,000 lbs/yr thresholds were determined by summing the number of reports meeting the minimum throughput. An example calculation, based on the data in Table I-8 for the 1 pound and 1,000 pound thresholds are shown below:

- Number of facilities at the 1 lb threshold: (610+179+176+101+119+44) = 1,229
- Number of facilities at the 1,000 threshold: (44) = 44

At a reporting thresholds of 1 lb/yr, 10 lbs/yr, 100 lbs/yr, and 1,000 lbs/yr, 1,229, 440, 440, and 44 additional facilities are expected to report for PCBs, respectively.

TABLE I-8
ESTIMATED PCB PROCESSING FOR SIC CODE 5171 MODEL FACILITIES

Model				PCB Analysis		
Model Facility Number	**Number of Facilities Represented By Each Model**	**Fuel Type**	**Annual Throughput (10^3 gal/yr)**	**% of Facilities Handling No. 6 Residual fuel oil**	**Facilities Handling No. 6 Residual Fuel Oil**	**Estimated PCB Throughput per Facility (lb/yr)**
1	1,906	No. 6 Fuel Oil	45	32%	610	2
2	558	No. 6 Fuel Oil	61	32%	179	2
3	551	No. 6 Fuel Oil	4,809	32%	176	189
4	317	No. 6 Fuel Oil	12,022	32%	101	474
5	372	No. 6 Fuel Oil	24,045	32%	119	947
6	138	No. 6 Fuel Oil	48,090	32%	44	1,895

Summary

Industries manufacturing, processing, or otherwise using PCBs that may submit TRI reports at the lower thresholds are presented in Table I-9. An estimate of the number of facilities currently reporting to TRI is also provided. These facilities have met the current TRI reporting thresholds of 10,000 pounds per year for otherwise use, 25,000 pounds per year for either manufactured or processed, and the current *de minimis* level of 0.1%.

TABLE I-9
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR POLYCHLORINATED BIPHENYLS (PCBS)

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds[c]	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
22	Textile Mill Products	85	1	0[a]	0[a]	0[a]	0[a]
26	Paper and Allied Products	111	0	0[a]	0[a]	0[a]	0[a]
28	Chemicals and Allied Products	151	1	0[a]	0[a]	0[a]	0[a]
29	Petroleum Refining Related Industries	176	1	0[a]	0[a]	0[a]	0[a]
30	Rubber and Miscellaneous Plastics Products	237	1	0[a]	0[a]	0[a]	0[a]
32	Stone, Clay, Glass, and Concrete Products	178	1	0[a]	0[a]	0[a]	0[a]
33	Primary Metal Industries	100	2	0[a]	0[a]	0[a]	0[a]
34	Fabricated Metal Products, Except Machinery and Transportation Equipment	447	1	0[a]	0[a]	0[a]	0[a]
36	Electronic and Other Electrical Equipment and Components, Except Computer Equipment	216	1	0[a]	0[a]	0[a]	0[a]

TABLE I-9
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR POLYCHLORINATED BIPHENYLS (PCBS)

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees	Number of Facilities Reporting To TRI at Current Thresholds[c]	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
49	Electric Services (4911)	124	0[b]	Coal: 244 Oil: 104	Coal: 170 Oil: 82	Coal: 29 Oil: 66	Coal: 7 Oil: 32
	Electric and Other Services (4931)	98		Coal: 123 Oil: 82	Coal: 86 Oil: 65	Coal: 15 Oil: 52	Coal: 4 Oil: 25
	Combined Utilities (4939)	14		Coal: 12 Oil: 12	Coal: 9 Oil: 9	Coal: 2 Oil: 7	Coal: 0 Oil: 4
4953	Commercial Hazardous Waste Treatment	28	28	11	11	11	9
5171	Petroleum Bulk Stations & Bulk Terminals	3,842	0	1,248[d]	448[d]	448[d]	45[d]
20 - 39	Combustion Sources	2,177	0[b]	1,798	1,430	671	61
	TOTAL FOR ALL FACILITIES	**7,984**	**37**	**3,634**	**2,310**	**1,301**	**187**

a - Total number of facilities have been adjusted for oil combustion in industrial boilers to avoid double counting.
b - The number of facilities reporting to TRI at current threshold is zero since the PCB usage concentration (< 50 ppm) is below the current *de minimis* level.
c - Based on the 1995 TRI database.
d - The number of facilities may differ from those presented in Table I-8 due to rounding of the percent of facilities handling each fuel type.

I.4 CONCLUSIONS

As a result of lowering the TRI reporting thresholds, an estimated additional 187 to 3,634 reports may be anticipated for PCBs, depending on the threshold. The estimated number of reports at each threshold is presented below:

- 1 pound 3,634
- 10 pounds 2,310
- 100 pounds 1,301 and
- 1,000 pounds 187.

LITERATURE CITED

1. ATSDR (1997). ToxFAQs- Polychlorinated Biphenyls (PCBs). Http://atsdr1/atsdr.cdc.gov:8080/tfacts17.html.

2. Eisler, R. (1986). Polychlorinated Biphenyl Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review. U.S. Fish Wildl.Serv. Biol. rep. 85(1.7). 72.

3. Federal Register Notice (1998). Vol. 63, No. 69. FRN 17847-17848. Source Category Listing for Section 112(d)(2) Rulemaking Pursuant to Section 112(c)(6) Requirements. April 10.

4. The Royal Society of Chemistry (1996). Chlorinated Organic Micropollutants, Issues in Environmental Science and Technology Series.

5. U.S. Department of Commerce (1992). 1992 Census of Wholesale Trade: Subject Series - Miscellaneous Subjects. Bureau of the Census.

6. U.S. Department of Commerce. 1995 County Business Patterns. Bureau of the Census.

7. U.S. Department of Energy (1997). Manufacturing Consumption of Energy 1994. DOE/EIA-0512. December.

8. U.S. Department of Health and Human Services (1995). Toxicological Profile for Polychlorinated Biphenyls, Draft. August.

9. U.S. EPA (1995). Profile of the Petroleum Refining Industry. EPA 310-R-95-013. Office of Enforcement and Compliance Assurance. September.

10. U.S. EPA (1987). Locating and Estimating Air Emissions From Sources of Polychlorinated Biphenyls (PCB). Office of Air and Radiation, Office of Air Quality Planning and Standards. EPA-450/4-84-007n. May.

11. U.S. EPA (1996). Formation and Sources of Dioxin-Like Compounds. National Center for Environmental Assessment. November.

12. U.S. EPA (1997a). Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313. Office of Pollution Prevention and Toxics. April.

13. U.S. EPA (1997b). Emergency Planning and Community Right-to-Know Act Section 313 Questions and Answers. Office of Pollution and Prevention and Toxics. November.

14. U.S. EPA (1997c). 1990 Emissions Inventory of Section 112(c)(6). June. Http://www.epa.gov/ttnuatw1/112c6/112c6fac.html.

15. U.S. EPA (1997d). Management of Polychlorinated Biphenyls in the United States. Office of Pollution Prevention and Toxics, January.

16. U.S. EPA (1997e). Office of Drinking Water and Health. Polychlorinated Biphenyls (PCBs) Chemical Fact Sheet. Http://www/epa.gov/OGWDW/dwh/t-soc/pcbs.html.

17. U.S. EPA (1997f). Polychlorinated Biphenyls (PCBs). Http://www.epa.gov/ttn/uatw/hlthef/polychlo.html.

18. U.S. EPA (1997g). Unintentional Manufacturers and Importers of PCBs (Under Section 6 of TSCA).

19. U.S. EPA (1998a). Cost Impacts of the Final Regulation Amending the PCB Regulations at 40 CFR Part 761. Office of Pollution Prevention and Toxics. April.

20. U.S. EPA (1998b). PCB Home Page at EPA. Office of Pollution Prevention and Toxics. Http://www.epa.gov/opptintr/pcb.

21. U.S. EPA (1998c). 1995 Toxics Release Inventory (TRI) Database. Office of Pollution Prevention and Toxics.

22. Radian (1993). Memo from Joe Mangino et al. (Radian) to Anne Pope (EPA) regarding the Inventory Plan for Section 112(c)(6) Pollutants. Sept. 23, 1993, pp. A-29 to A-32 and A-42 to A-44.

23. 40 CFR 761.180. Part 761: Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions. Subpart J: General Records and Reports. 761.180: Records and Monitoring.

24. Abt Associates (1998). Spreadsheet Calculating the Number of Facilities in SIC 4953 Exceeding Reporting Thresholds for PCBs.

PERSONAL COMMUNICATION

1. Martig (1998). Teleconference between ERG and Mr. Tony Martig, U.S. EPA's Region V PCB Coordinator. PCB Usage in SIC Codes 20 through 39. June 21, 1998.

APPENDIX J
TETRABROMOBISPHENOL A

J.1 CHEMICAL PROFILE

Tetrabromobisphenol A $(C_6H_2Br_2OH)_2C(CH_3)_2$ (CAS 79-94-7), otherwise known as TBBPA, is a white, crystalline powder that is soluble in methanol and ether. TBBPA is a brominated flame retardant and is often used in plastics and engineering resins for printed circuit boards and computer equipment (Hardy, 1998).

J.1.1 PRODUCTION

TBBPA and its derivatives are the largest globally produced brominated flame retardants. They account for approximately 100 million pounds of the 300 million pound annual brominated flame retardant industry (Humer, 1993). TBBPA is produced by ring bromination of bisphenol A (Ashford, 1994).

Two of the three major world producers of TBBPA, Great Lakes Chemical Corporation and Albemarle Corporation, are located in the United States. In the early 1990s, both companies initiated multimillion dollar expansion projects to meet the increasing demand for TBBPA. Great Lakes Chemical Corporation has a facility in El Dorado, Arkansas (Humer, 1993). Albemarle Corporation purchased its facility in Magnolia, Arkansas from Ethyl Corporation, which acquired the facility from Dow Chemical (Chemical Marketing Reporter, 1988).

J.1.2 USES

TBBPA is used as a reactive or additive flame retardant in polymers, such as acrylonitrile-butadiene-styrene (ABS), epoxy and polycarbonate resins, high-impact polystyrene, phenolic resins, adhesives, unsaturated polyester resins, thermoplastic polyesters, and as a replacement for octa diphenyl oxide (DPO) in styrenics (Humer, 1993; Environmental Health Criteria Database). As a reactive flame retardant, TBBPA is covalently bound to a polymer backbone to produce an oligomer that is flame retardant and is often used in electronic equipment, particularly printed circuit boards (Hardy, 1998). The epoxy is purchased in liquid form with 75-85 percent solids and 15-25 percent solvent, usually acetone. TBBPA accounts for approximately 30 percent of the solids in the resin. When used in this application, TBBPA ceases to exist as TBBPA and becomes a part of the polymer (Hardy, 1998).

TBBPA is also used as an additive flame retardant in plastics. In these applications, unlike the reactive uses described above, TBBPA retains its chemical identity and continues to exist in the plastic. The most prevalent example of this use is in ABS. Literature indicates several possible uses for TBBPA in plastic and engineering resins for applications such as televisions,

VCRs, computer wire and cable, automotive components, TV cabinets, structural cases for electrical and electronic devices, and other thermoplastics (Naude, 1995). The concentration of TBBPA in such plastics is approximately 15 percent (Hardy, 1998).

Although these applications are all possible uses for TBBPA, one of the two U.S. producers has indicated that the primary uses of the chemical are for epoxy resins used in printed circuit boards and as an additive to ABS, particularly ABS used in the production of computer housings (Hardy, 1998).

J.2 CURRENT TOXIC RELEASE INVENTORY (TRI) STATUS

TBBPA is not currently on the list of TRI chemicals. A similar chemical that is currently reported to TRI is decabromodiphenyl oxide (DBDPO). DBDPO is also a brominated flame retardant that is used in polyolefins, styrenic, polyamide, and polyester resins (Albemarle, 1997). In 1995, there were approximately 130 Form R reports for DBDPO submitted to TRI under a number of SIC codes. The primary SIC codes under which reports were submitted include: SIC code 22 (Textiles); SIC code 26 (Pulp and Paper); SIC code 28 (Chemicals); SIC code 30 (Rubber and Plastics); SIC code 3357 (Drawing and Insulating of Nonferrous Wire); SIC code 36 (Electronic Equipment and Components, Except Computers); and SIC code 38 (Measuring, Analyzing, and Controlling Instruments) (EPA, 1997).

J.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS

This section presents estimates of the number of TRI reports for TBBPA at the lower reporting thresholds of: 1 pound, 10 pounds, 100 pounds, and 1,000 pounds. The following estimates assume that the *de minimis* exemption would be eliminated; thus TRI reporting is expected from facilities manufacturing, processing or otherwise using TBBPA above reporting thresholds, regardless of the concentration.

J.3.1 ANALYTICAL METHODS

This section describes the process used to estimate the number of facilities that may submit TRI reports at the lower reporting thresholds. Industries manufacturing, processing, or otherwise using TBBPA that may submit TRI reports at the lowered thresholds are presented in Table J-1 along with the results of the analysis.

Great Lakes Chemical Corporation in El Dorado, Arkansas and Albemarle Corporation in Magnolia, Arkansas are the two facilities that produce TBBPA domestically. From the 1995 TRI database, it is known that these facilities report the production of other brominated flame retardants under SIC codes 2819 and 2869 (EPA, 1997). While the production capacity of each of the facilities is considered confidential by the owner companies, it is known that TBBPA and its derivatives account for approximately 100 million pounds of the annual brominated flame retardant industry (Humer, 1993). Note that while a facility manufacturing TBBPA derivatives

would count the TBBPA towards thresholds, a facility using a TBBPA derivative would not count the derivative toward the TBBPA threshold.

The literature lists several possible uses for TBBPA as indicated in Section J.1.2. Based on information from the manufacturers of the chemical, many of the possible applications of TBBPA are not widely practiced, if at all. TBBPA's primary use is as a reactant flame retardant in epoxy resins used in printed circuit board production. The second largest use of TBBPA is as an additive flame retardant in computer housings made of ABS. The third main use of TBBPA is in the manufacture of TBBPA-epoxy oligomer, which is then blended into ABS as an additive flame retardant. Unlike DBDPO, TBBPA is not used in textiles or paper products (Duhon, 1998; Hardy, 1998).

Using this information, SIC codes 2821, 2899, 3571, 3572, 3575, 3672, and 5169 were included as classifications under which facilities might report the processing or otherwise use of TBBPA to TRI. Although the total amount of TBBPA manufactured/used each year is known to be approximately 100 million pounds (Humer, 1993), the distribution of this total among the individual SIC codes is unknown. The number of facilities in each SIC code is therefore shown in Table J-1 as a range. The low end of the range is zero due to the uncertainty of how many facilities in each specific SIC code would report to TRI for TBBPA. The high end of the range is from the 1995 County Business Patterns (U.S. Census Bureau, 1995) for facilities with 10 or more employees except in the cases of SIC codes 2899 and 5169. The actual number of facilities with TBBPA in reportable amounts is expected to be much less than the high end of the range. Not all facilities are expected to make products requiring flame retardants, and there are numerous flame retardants other than TBBPA that may be used at these facilities.

SIC code 2899 includes a broad spectrum of "Chemicals and Chemical Preparations, n.e.c." For this reason, it was estimated that only 10 percent of facilities under this classification with 10 or more employees would report to TRI for TBBPA. For SIC code 5169, a survey of 9 chemical wholesalers was conducted. None of the 9 chemical wholesalers contacted reported the sale of TBBPA (ERG, 1998). Therefore, for this analysis, 1 percent of the 717 facilities in this industry that are expected to report under current thresholds, or 7 facilities were assumed to repackage and distribute TBBPA.

It is assumed that commercial hazardous waste treatment facilities in SIC Code 4953 receive waste streams containing Tetrabromobisphenol A (TBBPA) from the two TBBPA manufacturers identified in SIC Code 2819 - Industrial Inorganic Chemicals, n.e.c. and SIC Code 2869 - Industrial Organic Chemicals, n.e.c. It is further assumed that the two TBBPA manufacturers ship their wastes to separate hazardous waste treatment facilities, accounting for two TBBPA reports under all of the lower reporting thresholds. The estimated number of reports is adjusted by a factor of two to account for the possibility that the two manufacturers may ship their wastes to more than two hazardous waste treatment facilities. Industry groups processing or otherwise using TBBPA incorporate the chemical into their product and are, therefore, not expected to generate waste streams with more than trace amounts of TBBPA.

The estimated number of facilities reporting to TRI for TBBPA at the lower reporting thresholds are shown in Table J-1. The low ends of the ranges were estimated using a regression model developed to predict the number of TRI Form R reports that would be submitted to EPA as a result of new additions to the EPCRA Section 313 list of toxic chemicals (ICF, 1996). The model was developed using 206 chemicals reported to TRI in 1990 at current thresholds. Taking into account the annual production volume of TBBPA (100 million pounds) and its commercial functions, the model predicted that 146 reports would be submitted at current thresholds.

The maximum number of reports expected was generated based on the fact that TBBPA is used in fairly high concentrations in many plastics (15-30 percent in many cases) (Hardy, 1998). This high concentration led to the assumption that most of the facilities using TBBPA or plastics treated with TBBPA are using large amounts of the chemical and would therefore report to TRI at the current thresholds (25,000 pounds for manufacturing or processing and 10,000 pounds for otherwise use) if TBBPA were currently listed. It was estimated that only an additional 10 percent of the total number of facilities would submit reports at any of the lower thresholds, as shown below:

(2,278 facilities × 10%) = 228 facilities.

Adding the 228 reports expected at lower thresholds to the 146 reports expected at current thresholds yields an upper bound of new reports of 374 reports. An additional 4 reports are then added to the lower and upper end of the range to account for reports estimated to be generated by SIC Code 4953.

TABLE J-1
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR TETRABROMOBISPHENOL A (TBBPA)

SIC Code	Industry Sector	Total Number of Facilities with ≥10 Employees[a]	Number of Facilities Reporting To TRI at Current Thresholds	Number of Additional Facilities Submitting Reports at:			
				1 lb/yr	10 lbs/yr	100 lbs/yr	1,000 lbs/yr
2819	Industrial Inorganic Chemicals, n.e.c.	2	NA	1	1	1	1
2869	Industrial Organic Chemicals, n.e.c.		NA	1	1	1	1
2821	Plastics Materials, Synthetic Resins, and Non-vulcanized Elastomers	0 - 415	NA	0 - 415	0 - 415	0 - 415	0 - 415
2899	Chemicals and Chemical Preparations, n.e.c.	0 - 70	NA	0 - 70	0 - 70	0 - 70	0 - 70
28	**Chemicals and Allied Products Total**	2 - 487	NA	2 - 487	2 - 487	2 - 487	2 - 487
3087	Custom Compounding of Purchased Plastic Resins	0-441	NA	0-441	0-441	0-441	0-441
3571	Electronic Computers	0 - 288	NA	0 - 288	0 - 288	0 - 288	0 - 288
3572	Computer Storage Devices	0 - 105	NA	0 - 105	0 - 105	0 - 105	0 - 105
3575	Computer Terminals	0 - 87	NA	0 - 87	0 - 87	0 - 87	0 - 87
35	**Industrial and Commercial Machinery and Computer Equipment Total**	0 - 480	NA	0 - 480	0 - 480	0 - 480	0 - 480
3672	Printed Circuit Boards	0 - 863	NA	0 - 863	0 - 863	0 - 863	0 - 863
4953	Commercial Hazardous Waste Treatment	162	NA	4	4	4	4
5169	Chemicals and Allied Products, Wholesale	7	NA	7	7	7	7
	TOTAL FOR ALL FACILITIES	**9-2,278**	**NA**	**150 - 378**	**150 - 378**	**150 - 378**	**150 - 378**

n.e.c. Not Elsewhere Classified
NA: Not Applicable
[a] Sources of facilities with more than 10 FTEs are: U.S. EPA, 1997; U.S. Census, 1995; and ERG, 1998.

J.4 CONCLUSIONS

Based on what is known about the production and use of TBBPA, it is estimated that between 150 and 378 facilities would report to TRI for TBBPA at the lower reporting thresholds. This range applies to any threshold below the current thresholds because TBBPA is used as a flame retardant for plastics in relatively high concentrations.

LITERATURE CITED

1. Albemarle Corporation (1997). Chemical Profile for SAYTEX™ 102E Flame Retardant (Decabromodiphenyl Oxide). Doc. BC-1001. Available at http://www.albemarle.com/saytex.htm

2. Albemarle Corporation (1997). Chemical Profile for SAYTEX™ RB-100 Flame Retardant (Tetrabromobisphenol A). Doc. BC-1013. Available at http://www.albemarle.com/saytex.htm

3. Ashford, R. (1994). Ashford's Dictionary of Industrial Chemicals. Wavelength Pub. Ltd.

4. Chemical Marketing Reporter (1988). U.S. bromine market revival seen after loss of EDB. March, vol. 233. N. 13. p 5,40.

5. Eastern Research Group (1998). Survey of facilities reporting to TRI under SIC 5169. June.

6. Environmental Health Criteria Database (1995). Summary and Evaluation; Conclusions and Recommendations on the Tetrabromobisphenol A (TBBPA). gopher://gopher.who.ch:70/00/.anonymousftp/programme/PCS/ehc/ejc172.asc

7. Humer, Caroline (1993). Flame Retardants Switch Within Brominated Market. Chemical Marketing Reporter. February 1993. vol 243. N. 7. p 27-28.

8. ICF Incorporated (1996). A Statistical Model of TRI Reporting. Prepared for Regulatory Impacts Branch, Economics, Exposure and Technology Division, Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency. September.

9. Naude, Alice (1995). Plastic Additives 1995: Fired Up. Chemical Marketing Reporter. June, Vol. 247. n. 24. p. SR11-SR12.

10. U.S. Census Bureau (1995). 1995 County Business Patterns (United States).

11. U.S. EPA (1997). 1995 Toxics Release Inventory (TRI) Database. Office of Pollution Prevention and Toxics.

12. U.S. National Library of Medicine (1998). Hazardous Substances Data Bank. Tetrabromobisphenol A. Issue 98-1.

PERSONAL COMMUNICATIONS

1. Duhon, Dale (Great Lakes Chemical Corp., 1998) Letter to John Carter (ERG). Re: Information Request for Tetrabromobisphenol A (June 10).

2. Hardy, Marcia L. (Albemarle Corp., 1998). Letter to John Carter (ERG). Re: Request for information on TBBPA (June 1).

APPENDIX K
VANADIUM AND VANADIUM COMPOUNDS

K.1 CHEMICAL PROFILE

Pure vanadium (CAS 440-62-2) is a silvery-white ductile metal often found in crystals (ATSDR, 1997). It occurs naturally in compounds contained in ores such as carnotite, patronite, roscoelite, vanadinite, and is most often extracted from vanadiferous magnetite. Vanadium increases strength, toughness, fatigue resistance, and ductility in metals (United States Steel, 1985). Vanadium is used as an additive to alloys, carbon and tool steels, superalloys, stainless steel and cast irons, catalysts, ceramics, and electronic applications (Hilliard, 1996b). Vanadium compounds are often found in building and heavy construction materials, automobile parts (e.g., springs and ball bearings), and aircraft engine parts (ATSDR, 1997). Vanadium is present in natural gas, coal, and residual fuel oil; vanadium compounds (vanadium pentoxide) are formed during combustion.

K.1.1 PRODUCTION

Vanadium is present in iron-bearing minerals in Colorado, phosphate rocks in the western U.S., and some titaniferous magnetites in the eastern and western U.S. (Kroschwitz, 1994). Vanadium is typically produced as a byproduct of the processing of ferrophosphorus slags (Hilliard, 1996b). Secondary production of vanadium commonly occurs through recovery of vanadium from spent catalysts, tool steel scrap, uranium/vanadium-bearing ores, coal-burning power plant ash, and petroleum residues. The U.S. vanadium production industry consists of nine firms, only eight of which have active operations (Hilliard, 1996a).

K.1.2. USES

In 1996, vanadium consumption was approximately 10 million pounds. Table K-1 presents a distribution of domestic vanadium consumption by end use during 1996. As shown in the table, approximately 90 percent of vanadium is used as an alloying agent for steel products (ferrovanadium). Of the steel products, carbon and full alloy steel were the predominant end uses for vanadium, representing approximately 60 percent of reported consumption. Cast iron, alloys, superalloys, vanadium chemical catalysts for the manufacture of maleic anhydride and sulfuric acid, and vanadium ceramic pigments accounted for the remaining 10 percent of vanadium use.

TABLE K-1
1996 U.S. VANADIUM CONSUMPTION BY END USE

End Use	Quantity (lbs of Vanadium) [a]
Steel:	
Carbon	4,010,000
Stainless and heat resisting	47,800
Full alloy	2,270,000
High-strength low-alloy	1,960,000
Tool	955,000
Unspecified	W[b]
Total	9,260,000
Cast irons	W[b]
Superalloys	35,300
Alloys (excluding steels and superalloys):	
Cutting and wear-resistant materials	571
Welding and alloy hard-facing road and materials	7,140
Magnetic alloys	W[b]
Other alloys	851,000
Chemical and ceramic uses:	
Catalysts	W[b]
Pigments	W[b]
Miscellaneous and unspecified	110,000
Grand total	**10,300,000**

Source: (Hilliard, 1996b).
[a] Data are rounded to three significant digits; may not add to total shown.
[b] W indicates the information is withheld to avoid disclosing company proprietary data.

The vanadium end use materials (alloys) may be incorporated into electronic applications (batteries) and titanium-aluminum-vanadium aerospace alloys (Hilliard, 1996b). Industry sectors using vanadium materials include: building and heavy construction (33%), machinery and tools (28%), transportation (27%), and other (12%) (Hilliard, 1996a).

K.2 CURRENT TOXIC RELEASE INVENTORY (TRI) STATUS

Vanadium (fume or dust) is currently reported to the Toxic Release Inventory (TRI); vanadium compounds are not currently reportable to TRI. Table K-2 presents a summary of current reporting on vanadium (fume or dust) to TRI in 1996. A total of 37,668 pounds of vanadium was released and reported under Section 8.1. A total of 279,958 pounds was reported under Section 8 (8.1-8.8), which consists of releases, energy recovery, recycling, treatment, and one-time releases. (EPA, 1998a)

TABLE K-2
SUMMARY OF TRI REPORTING FOR VANADIUM (FUME OR DUST), 1996

SIC Code Name	SIC Code	Number of Form Rs	Number of Form As
Nitrogenous fertilizers	2873	0	1
Petroleum refining	2911	3	0
Primary metal industries	33	1	1
Metal stampings, n.e.c.*	3469	1	0
Machinery, except electric	35	2	1
Signs and advertising specialties	3993	1	0
No SIC reported		3	0
	Total	**11**	**3**

Source: (EPA, 1998a)
* "Not elsewhere classified" indicated by "*n.e.c.*"

Under the final rule, additional reporting may come from industrial sectors such as chemical industries (SIC Code 28), petroleum refining (SIC Code 2911), primary metals industries (SIC Code 33), and combustion sources such as electric utilities and industrial facilities with boilers.

K.3 ESTIMATED NUMBER OF ADDITIONAL REPORTS

K.3.1 ANALYTICAL METHODS

This section discusses the process used to estimate the number of additional TRI reports for vanadium and vanadium compounds, assuming the activity qualifier (fume or dust) is removed and vanadium compounds are added to the EPCRA Section 313 list of reportable chemicals. The following estimates also assume that the *de minimis* concentration exemption would apply; thus, TRI reporting is not expected from facilities manufacturing, processing, or otherwise using vanadium and/or vanadium compounds above the current thresholds when concentrations are less than 1 percent.

The industries that may be most affected by the removal of the activity qualifier are combustion sources (see Appendix A), petroleum refining (SIC Code 2911), primary metals (SIC Code 33), and commercial hazardous waste facilities (SIC Code 4953).

Coal Mining (SIC Code 12)

Vanadium is processed as a trace metal found in coal, and is processed during coal benification. Facilities performing only extraction are not reportable to TRI. Plants performing extraction and benification are reportable to TRI. It was assumed that all of the coal produced domestically would be processed by facilities that would be subject to TRI reporting. There are 321 coal mining facilities conducting benification that might potentially be affected by the final rule (U.S. EPA, 1997b).

The coal mining industry vanadium activity in the United States is based on the following data and calculations:

- 1,032,974,000 tons of coal produced in 1995 (U.S. Department of Energy, 1987, 1992-1996)
- 12 ppm vanadium in coal (Christman, et al., 1980)
- 1,032,974,000 tons coal x (2000 lbs/ton) x 0.000012 lb V/lb coal
  = 24,791,376 lbs vanadium metal/year

The concentration of vanadium, however, is lower than the *de minimis* level; therefore, no additional reports are expected for this SIC Code.

Chemicals and Allied Products (SIC Code 28)

Chemicals and allied products (SIC Code 28) includes companies recovering vanadium from spent catalysts and petroleum residues. There are 65 potential facilities, including 29 sulfuric acid, 26 chemical catalyst, 5 maleic anhydride, and 5 phthalic anhydride manufacturing facilities (Chemical Profile, 1998; U.S. Department of Commerce, 1992). None of these companies, however, are known to otherwise use vanadium above the current otherwise use threshold of 10,000 lbs. Therefore, no additional reports are expected from this SIC Code.

Petroleum Refining Facilities (SIC Code 2911)

The number of additional petroleum refining facilities (SIC Code 2911) that may submit TRI reports is based on the number of petroleum refineries that use certain processes that would be expected to generate spent catalysts with high concentrations of vanadium. Vanadium is one of several metals that are considered to be catalyst poisons. As such, vanadium collects on catalysts and reduces their effectiveness. Vanadium oxide is also used as a base material for some molybdenum and/or cobalt catalysts used in hydrotreating operations (Gary & Handwerk, 1994).

The *Profile of the Petroleum Refining Industry* (U.S. EPA, 1995a) lists 176 facilities and their refining capacity. The total capacity for the entire industry is 15.2 million barrels per day (U.S. Department of Energy, 1997b). The density of crude oil ranges between 6.7 and 9 lbs/gal, and the vanadium concentration between 5 and 12 ppm (Golden and Martin, 1995) in the gas/oil product. To calculate the amount of vanadium processed through the refining industry, the density of crude oil was assumed to be 7.3 lbs/gal and the vanadium concentration was assumed to be 8.5 ppm. The total vanadium activity for the industry was calculated as follows:

15,200,000 bbl/day × 365 days/yr × 42 gal/bbl × 7.3 lbs/gal × 8.5 lbs/10^6 lbs = 14,400,000 lbs/yr as V

Refineries using crude oil with high levels of vanadium must remove some of the vanadium from feed stocks through certain catalytic operations such as catalytic cracking. Most (80% to 90%) of the metals in crude oil are in the asphaltenes fraction with the remaining metals in the resin fraction. These fractions are usually removed before going to the catalytic cracking process so that the metals do not poison the catalyst. The vanadium concentrations in the asphaltene and resin fractions, however, are far lower than 1% and thus would qualify for the *de minimis* exemption (Gary & Handwerk, 1994). These fractions are usually blended into asphalt or residual fuels and sold as products.

Although some vanadium will be present in the catalytic cracking feed stock, and therefore will collect on the cracking catalyst, it was estimated that the concentration of vanadium in the spent catalytic cracking unit catalysts is present at a concentration of 0.2% or less (Gary and Handwerk, 1994). Cracking catalysts today can have up to 10,000 ppm of nickel and vanadium before they must be replaced or regenerated. Since nickel is usually 4 times more prevalent than vanadium, the concentration of vanadium is estimated to be roughly 2,000 ppm or 0.2% (Gary and Handwerk, 1994).

Some refineries further process the asphaltene and resin fractions to remove metals and for other purposes including making more saleable products and removing other contaminants. The processes include hydroprocessing, hydrocracking, and solvent extraction. If the fractions are processed in such a way, vanadium can exceed 1 percent in the spent catalyst or solvent. A total of 75 refineries are estimated to perform catalytic hydrocracking or solvent extraction or hydrotreating/hydroprocessing on residuals (DOE/EIA, 1997). Industry contacts indicate that the spent catalyst resulting from these catalytic processes may be landfilled or shipped off-site for reclamation (Crane, 1999). Therefore, 75 petroleum refineries are expected to report to TRI under the final rule as they may exceed both the otherwise use threshold of 10,000 lbs and the *de minimis* concentration of 1 percent.

Primary Metal Industries (SIC Code 33)

Primary metal industries (SIC Code 33) account for most of the 10 million pounds per year of vanadium consumed. Vanadium is processed as a trace metal in coal used in coke making.

In addition, vanadium compounds such as ferrovanadium are added to steel to enhance various properties. The number of additional primary metal processors that may submit TRI reports is based on a *Preliminary Study of the Iron and Steel Category* (EPA, 1995b). The following data and calculations are used for the estimate of vanadium activity in this industry:

- 33,011,000 tons of coal used to produce coke (U.S. Department of Energy, 1996).
- 12 ppm vanadium in coal (Christman et al., 1980).
- 33,011,000 tons coal/year x (2,000 lbs/ton) x (0.000012 lbs V/lb coal)
  = 792,260 lbs vanadium/year in coke
- 9,259,000 lbs vanadium/year added to steel in the form of ferrovanadium (Hillard, 1994; U.S. Department of Commerce, 1994 and 1995).

There are 84 facilities in SIC 33 operating these processes (EPA, 1995(b)). All 84 facilities are expected to report to TRI.

Fabricated Metal Products (SIC Code 34), Machinery, Except Electric (SIC Code 35), and Transportation Equipment (SIC Code 37)

In SIC Codes 34, 35, and 37, vanadium is processed as a component in steel used to enhance strength and durability. Usage amounts assume one-third of vanadium added to the primary metals industry (SIC Code 33) is used in each metals manufacturing sectors (U.S. EPA, 1983). The amount of vanadium used in each sector was calculated as follows:

- Total vanadium into steel: (792,000 lbs + 9,259,000 lbs) = 10,051,000 lbs
- Assuming steel usage is divided equally between the three major steel consuming SIC Codes, then:
  10,051,000 × 0.33 = 3,317,000 lbs/yr for SIC Codes 34, 35 and 37.

An alloy exemption for vanadium is expected to reduce expected reporting for facilities in the following sectors: fabricated metal products (SIC Code 34), machinery, except electric (SIC Code 35), and transportation equipment (SIC Code 37). Under the alloy exemption, once vanadium is incorporated into an alloy, subsequent operations such as cutting, grinding, shaving, and shaping will not be applicable to threshold determinations for TRI reporting on vanadium. Thus, for the above SIC Codes, it is estimated that no additional TRI reports would be received.

Electric Services (SIC Code 4911), Electric and Other Services Combined (SIC Code 4931), and Combination Utilities, n.e.c. (SIC Code 4939)

At Electric Utilities, vanadium is a trace metal found in fossil fuels. Vanadium pentoxide is coincidentally manufactured during fuel combustion. The amount of vanadium compound manufactured by SIC 4911 was determined with the following data and assumptions:

- Total coal combustion in 1996 = 807,536,103 tons
- Total oil combustion in 1996 = 118,315,936 bbl
- 12 ppm vanadium in western coal
- 4 ppm vanadium in residual oil (No. 6)
- Conversion of vanadium to vanadium pentoxide during combustion
- The density of residual oil was assumed to be 7.88 lbs/gal (Christman et al., 1980; U.S. Department of Energy, 1996)

Coal and oil combustion information was not available for SIC Codes 4931 or 4939.

The potential number of facilities for each of the three industries and the number of additional reports expected for each industry are presented in Table K-4. These estimates are based on the percentage of coal or oil facilities in SIC Code 4911 which exceed the threshold.

Commercial Hazardous Waste Treatment (SIC Code 4953)

In SIC Code 4953, vanadium is processed or otherwise used as a trace contaminant in waste streams to RCRA Subtitle C facilities. There are 164 facilities subject to TRI for SIC 4953: 21 hazardous waste landfills; 9 underground injection wells; 71 biological/chemical treatment facilities; 53 hazardous waste incinerators; and 10 other hazardous waste TSDFs (Treatment, Storage, and Disposal Facilities) (U.S. EPA, 1997b).

Information on the prevalence of vanadium at commercial hazardous waste treatment facilities is limited to transfers of vanadium fume or dust to off-site locations from facilities reporting to TRI. While these data may accurately represent the amount of vanadium fume or dust handled by commercial waste facilities, they cannot be used to estimate the amount of vanadium or vanadium compounds handled by waste treatment facilities. Therefore, the number of reports expected for cobalt/cobalt compounds, a chemical with similar applications (e.g., use in metal alloys and catalyst), was used as a proxy for the number of vanadium reports expected under the final rule. The following approach was used to estimate the number of reports for cobalt/cobalt compounds.

To estimate the number of commercial hazardous waste treatment facilities that may report on this chemical at the current otherwise use thresholds, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose. First, TRI data may underestimate the *number of reporting facilities* because TRI- subject

hazardous waste facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the hazardous waste facility may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities, and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of hazardous waste treatment facilities at which amounts of cobalt/cobalt compounds would exceed an otherwise use threshold of 10,000 lbs were counted (Abt Associates Inc., 1998a).

Petroleum Bulk Stations & Bulk Terminals (SIC Code 5171)

Petroleum bulk stations and bulk terminals process vanadium as a trace constituent in No. 6 residual fuel oil, No. 2 distillate fuel oil, crude oil, and jet fuel. The estimated number of facilities in SIC Code 5171 expected to submit reports for vanadium and vanadium compounds is based on the methodology presented in Appendix H of the industry expansion EA. This methodology does not consider extent to which facilities handle more than one product type containing the same PBT chemical and overestimates of the number of facilities expected to report for each chemical. Therefore, the methodology was enhanced to consider the overlap of multiple products handled by a single facility. Data on fuel throughput and chemical concentration by fuel type were used to estimate the unique number of facilities that will file reports for each PBT chemical. The estimate was based on a set of six model facilities described in the *Economic Analysis of the Final Rule to Add Certain Industrial Groups to EPCRA Section 313* (EPA, 1997b), each characterized by its throughput of petroleum products containing at least one TRI constituent above *de minimis* levels. Each model facility is assumed to represent a number of facilities with similar fuel throughput characteristics, a given subset of which are assumed to handle each of the petroleum products. The percentage of facilities handling each petroleum product was calculated using data from the Independent Liquid Terminals Association (ILTA) directory which identifies the different combination of products handled by each member facility.

The number of petroleum bulk stations and terminals that may submit additional TRI reports for vanadium and vanadium compounds were estimated by the following procedure:

- Using available concentration data, calculate the minimum annual throughput required to exceed the reporting threshold for vanadium in each petroleum product;
- For each model facility, identify the petroleum products for which annual throughput is sufficient to exceed the reporting threshold for vanadium;
- Estimate the percentage of facilities in the ILTA directory that handle at least one of the petroleum products with throughputs sufficient to exceed the reporting threshold for each model facility;

- Apply the percentage developed in the previous step for each model facility to number of facilities represented by that model facility to estimate the number of facilities expected to submit a report for vanadium; and
- Calculate the total number of facilities expected to report at the reporting threshold by summing the number of facilities reporting for vanadium across all six model facilities.

The concentration of vanadium is 4 ppm in No.6 fuel oil and crude oil and 0.6 ppm in jet fuel and No. 2 fuel oil. Annual product sales at petroleum bulk stations and terminals were 11,017,867,000 gallons of No. 6 fuel oil, 42,245,575,000 gallons of crude oil, 6,402,192,000 gallons of jet fuel and 35,609,975,000 gallons of No. 2 fuel oil (Department of Commerce, 1992). The densities for No.6 fuel oil, crude oil, and No. 2 fuel oil are 7.88, 7.3, and 7.05 pounds per gallon respectively (EPA, 1995a). The density of jet fuel was estimated at 6.7 pounds per gallon (API, 1992). The total quantity of vanadium processed through facilities in SIC Code 5171 totaled 1,757,221 pounds per year and was calculated as shown below:

No. 6 fuel oil: (11,017,867,000 gal oil/yr) × (7.88 lb oil/ gal oil) × (4 lb / 1 x 10^6 lb oil)
= 347,283 lbs vanadium/ yr
Crude oil: (42,245,575,000 gal oil/yr) × (7.3 lb oil/ gal oil) × (4 lb vanadium/1 × 10^6 lb oil)
= 1,233,571 lbs vanadium/ yr
No. 2 fuel oil: (35,609,975,000 gal oil/yr) × (7.05 lb oil/gal oil) × (0.6 lb vanadium/1 × 10^6 lb oil)
= 150,630 lbs vanadium/ yr
Jet fuel: (6,402,192,000 gal jet fuel/yr) × (6.7 lb fuel/ gal fuel) × (0.6 lb vanadium/1 × 10^6 lb fuel) = 25,737 lbs vanadium/ yr

Total vanadium activity for SIC Code 5171:
347,283 +1,233,571 + 150,630 +25,737 =1,757,221 lbs/yr

To determine the number of facilities that may submit additional TRI reports for vanadium and vanadium compounds, the model facilities and their corresponding annual product throughput estimates were used. Table K-3 presents the annual throughputs and total number of facilities represented by each model facility (EPA, 1997d), the estimated number of facilities represented by the model that handle each petroleum product with a vanadium constituent, and the estimated annual vanadium throughput at each model facility. Based on the analysis of the model facilities, no facility will have vanadium throughput in excess of the 25,000 lb process threshold.

TABLE K-3
ESTIMATED VANADIUM THROUGHPUT PER FACILITY BASED ON MODEL FACILITIES

Model				Vanadium Analysis	
Model Facility Number	**Number of Facilities for Each Model**	**Fuel Type**	**Annual Throughput (10^3 gal/yr)**	**Facilities Handling Each Fuel**	**Estimated Vanadium Throughput Per Facility (lb/yr)**
1	1,906	No. 6 Fuel Oil	45	610	1
		Crude Oil	371	248	11
		No. 2 Fuel Oil	1,665	1048	7
		Jet Fuel	45	172	0
2	558	No. 6 Fuel Oil	61	179	2
		Crude Oil	505	73	15
		No. 2 Fuel Oil	2,264	307	10
		Jet Fuel	62	50	0
3	551	No. 6 Fuel Oil	4,809	176	152
		Crude Oil	17,862	72	522
		No. 2 Fuel Oil	11,166	303	47
		Jet Fuel	2,738	50	11
4	317	No. 6 Fuel Oil	12,022	101	379
		Crude Oil	44,655	41	1,304
		No. 2 Fuel Oil	27,916	174	118
		Jet Fuel	6,847	29	28
5	372	No. 6 Fuel Oil	24,045	119	753
		Crude Oil	89,317	48	2,608
		No. 2 Fuel Oil	55,832	205	236
		Jet Fuel	13,694	33	55
6	138	No. 6 Fuel Oil	48,090	44	1,516
		Crude Oil	178,623	18	5,216
		No. 2 Fuel Oil	111,665	76	472
		Jet Fuel	27,389	12	110

Solvent Recovery Services (SIC Code 7389)

Vanadium is processed or otherwise used at solvent recovery facilities when it is received in waste streams. Information on its prevalence is limited to transfers of vanadium fume or dust to off-site locations from facilities reporting to TRI. While these data may accurately represent the amount of vanadium fume or dust handled by solvent recovery facilities, they cannot be used to estimate the amount of vanadium or vanadium compounds handled by solvent recovery facilities. Therefore, the number of reports expected for cobalt/cobalt compounds, a chemical with similar applications (e.g., use in metal alloys and catalyst), was used as a proxy for the number of vanadium reports expected under the final rule. The following approach was used to estimate the number of reports for cobalt/cobalt compounds.

To estimate the number of additional solvent recovery facilities that may report on this chemical, data on off-site transfers from TRI facilities in 1996 were used. The TRI data have certain limitations when used for this purpose. First, TRI data may underestimate the *number of reporting facilities* because TRI- subject solvent recovery facilities that receive wastes only from non-TRI facilities would not appear in TRI. Second, the TRI data may underestimate the *amount of the chemical* because it does not include transfers that the solvent recovery facilities may receive from non-TRI facilities.

Therefore, for this analysis, each facility was assumed to represent two facilities, and the amount transferred was doubled to account for additional quantities not captured under current TRI reporting. Following these adjustments, the number of solvent recovery facilities at which amounts of cobalt/cobalt compounds would exceed an otherwise use threshold of 10,000 lbs.

Table K-4 provides a summary of the number of facilities expected to submit additional TRI reports for vanadium and vanadium components under the final rule. Vanadium and vanadium compounds were considered together in Table K-4, since facilities can file a combined report if thresholds are exceeded for both the parent metal and compounds of that same metal. This analysis assumes that facilities exceeding current thresholds for both vanadium and vanadium compounds will file a single report (Abt Associates Inc., 1998b).

Combustion Sources (SIC Codes 20-39)

Facilities performing combustion operations with coal, residual fuel oil, and natural gas otherwise use vanadium as a trace constituent in these fuels. A detailed description of the number of facilities estimated to submit additional reports for vanadium due to combustion operations is provided in Appendix A. The total number of facilities burning coal, residual oil, or natural gas was adjusted to account for those with greater than 10 employees only and for combustion of nonprocess fuel.

TABLE K-4
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR VANADIUM AND VANADIUM COMPOUNDS

Industries	Total Amount of Vanadium/ Vanadium Compounds (lbs/yr)	Potential Number of Facilities	Concentrations	Number of Additional Reports Expected
Coal Mining (SIC Code 12)	24,791,000 (Christman, et al., 1980; U.S. DOE, 1987, 1992-1996)	321 (U.S. EPA, 1997b)	12 ppm western coal 35 ppm Appalachian 29 ppm Illinois coal (Christman, et al., 1980)	0
Chemicals and Allied Products (SIC Code 28)	328,000 (Hillard, 1994)	65 (Chemical Profile, 1998; U.S. DOC, 1992)	Concentrations in catalysts and sulfuric acid are unknown.	0
Petroleum Refining (SIC Code 2911)	14,400,000 (Golden and Martin, 1995; U.S. EPA, 1995a)	176 (U.S. EPA, 1995a)	0 - 5 ppm in crude (Gray and Handwerk, 1994) 21% in spent catalysts (Hillard, 1994)	75 (U.S. EPA, 1995a)
Primary Metal Industries (SIC Code 33)	792,000 (U.S. DOE, 1996) 9,259,000 (Hillard, 1994; U.S. DOC, 1995 and 1994)	84 (U.S. EPA, 1995b)	1-5% - tool steel <0.01% carbon steel 0.37% low alloy steel (U.S. Steel, 1985)	84 (U.S. EPA, 1995b)
Fabricated Metal Products (SIC Code 34)	3,300,000 (Hillard, 1994; U.S. DOC, 1995 and 1994)	20,900 (U.S. DOC, 1995)	1-5% - tool steel <0.01% carbon steel 0.37% low alloy steel (U.S. Steel, 1985)	0
Machinery, Except Electric (SIC Code 35)	3,300,000 (Hillard, 1994; U.S. DOC, 1995 and 1994)	25,400 (U.S. DOC, 1995)	1-5% - tool steel <0.01% carbon steel 0.37% low alloy steel (U.S. Steel, 1985)	0
Transportation Equipment (SIC Code 37)	3,300,000 (Hillard, 1994; U.S. DOC, 1995 and 1994)	5,900 (U.S. DOC, 1995)	1-5% - tool steel <0.01% carbon steel 0.37% low alloy steel (U.S. Steel, 1985)	0
Electric Services (SIC Codes 4911)	Coal: 49,818,000 Oil: 402,600 (Christman, et al., 1980; U.S. DOE, 1995)	Coal: 390 Oil: 124 (U.S. EPA, 1997b)	12 ppm western coal and 4 ppm in #6 residual oil. (Christman, et al., 1980; Hillard, 1994)	Coal: 294 Oil: 1
Electric and Other Services Combined (SIC Code 4931)	Not Available	Coal: 197 Oil: 98 (U.S. EPA, 1997b)	12 ppm western coal and 4 ppm in #6 residual oil. (Christman, et al., 1980; Hillard, 1994)	Coal: 148 Oil: 1

TABLE K-4
SUMMARY OF ESTIMATES OF ADDITIONAL TRI REPORTING FOR VANADIUM AND VANADIUM COMPOUNDS

Industries	Total Amount of Vanadium/ Vanadium Compounds (lbs/yr)	Potential Number of Facilities	Concentrations	Number of Additional Reports Expected
Combination Utilities, n.e.c. (SIC Code 4939)	Not Available	Coal: 19 Oil: 14 (U.S. EPA, 1997b)	12 ppm western coal and 4 ppm in #6 residual oil. (Christman, et al., 1980; Hillard, 1994)	Coal: 14 Oil: 0
Commercial Hazardous Waste Treatment (SIC Code 4953)	24,400	162 (U.S. EPA, 1997b)	Unknown	12
Petroleum Bulk Stations & Bulk Terminals (SIC Code 5171)	1,778,319	3,842 (U.S. EPA, 1997b)	4 ppm in #6 oil, crude oil	0 (U.S. EPA, 1997b)
Solvent Recovery Systems (SIC 7389)	Unknown	191	Unknown	0
Combustion Sources Only (SIC Codes 20 through 39)	Coal: 2,977,850 Oil: 280,470 (ERG, 1998; Radian, 1996; U.S. DOE, 1996; U.S. DOE, 1991-1997; U.S. DOE, 1997a; U.S. EPA, 1998a)	Coal: 849 Oil: 2,177 (ERG, 1998; U.S. DOE, 1997a)	12 mg/kg in western coal; 0.07 ppm in natural gas; 4 ppm in #6 fuel oil. (Christman, et al., 1980)	26 (U.S. DOE, 1997a)
Totals For All Facilities:	**51,024,000 (vanadium metal)** **53,978,000 (vanadium compounds)**	**60,700**		**655**

n.e.c. - not elsewhere classified

K.4 CONCLUSIONS

As a result of eliminating the activity qualifier for vanadium and adding vanadium compounds to TRI reporting, the estimated number of additional reports that may be submitted equals 655.

LITERATURE CITED

1. Abt Associates Inc. (1998a). Spreadsheet Calculating Number of Facilities in SIC 4953 Exceeding Reporting Thresholds for Various PBT Chemicals.

2. Abt Associates Inc. (1998b). Spreadsheet Calculating Number of Facilities in SIC 7389 Exceeding Reporting Thresholds for Various PBT Chemicals.

3. Agency for Toxic Substances and Disease Registry (ATSDR) (1997). ToxFAQs, Vanadium. Internet address: http://atsdr1/atsdr.cdc.gov:8080/tfacts58.html.

4. Baumeister, T., E.A. Avallone, and T. Baumeister III, Eds. (1979). *Marks' Standard Handbook for Mechanical Engineers*. Eighth Edition. McGraw-Hill Book Company.

5. Chemical Market Reporter. Chemical Profile: Maleic Anhydride. March 30, 1998.

6. Chemical Market Reporter. Chemical Profile: Phthalic Anhydride. April 17, 1998.

7. Christman, R., Eastern Research Group.

8. Christman, R.C., J. Haslbeck, B. Sedlik (1980). Activities, Effects and Impacts of the Coal Fuel Cycle for a 1,000-MWe Electric Power Generating Plant. Prepared for U.S. Nuclear Regulatory Commission.

9. Eastern Research Group (ERG), Inc. (1998). Industrial Combustion Coordinated Rulemaking database (ICCR).

10. Gary, J.H. and G.E. Handwerk (1994). Petroleum Refining Technology and Economics. Third Edition Marcel Dekker, Inc., New York, New York.

11. Golden, SW and G.R. Martin (1995). Controlling Vanadium from High Metals Crude Oil. Presented at the National Petroleum Refiners Association Annual Meeting, San Francisco, CA. March 10-21.

12. Hillard, H.E, U.S. Department of the Interior, Bureau of Mines (1994). The Materials Flow of Vanadium in the United States, Information Circular 9409.

13. Hilliard, H. (1996a). U.S. Geological Survey, Mineral Commodity Summaries - Vanadium. Internet address: http://minerals.er.usgs.gov:80/minerals/pubs/mcs/.

14. Hilliard, H. (1996b). U.S. Geological Survey, Mineral Information -Vanadium. 1996. Internet address: http://minerals.er.usgs.gov/minerals/pubs/myb.html

15. Kroschwitz, I. ed. (1994). Kirk- Othmer's Encyclopedia of Industrial Chemicals, 4th ed. John Wiley and Sons. New York, New York.

16. Radian International (1996). Cement Manufacturing Facility, Trial Burn Plan and QAPP. March.

17. United States Steel (1985). The Making, Shaping and Treating of Steel, 10th Edition.

18. U.S. Department of Commerce. 1992 Census of Manufactures, Industrial Series: Industrial Inorganic Chemicals for Industries 2812, 2813, 2816, and 2819. Bureau of Census.

19. U.S. Department of Commerce, Bureau of Census Current Industrial Reports (1995 and 1994). Steel Mill Products. Table 1. Value of Shipments of Steel Mill Products, by Class of Products: 1995 and 1994. Internet address: http://www.cesus.gov/industry/ma33b5.txt.

20. U.S. Department of Commerce. 1995 County Business Patterns (1995). Bureau of the Census. CBP/95-1.

21. U.S. Department of Energy (1987, 1992-1996). U.S. Coal Production by State. Table 1. Internet address: http://www.eia.doe.gov/cneaf/coal/cia/tlp01.txt.

22. U.S. Department of Energy (1994). Manufacturing Sector Establishments by Inputs for Heat, Power, and Electricity Generation. Table 2.3. Internet address: http://ftp.eia.doe.gov/p..overview/aer/aer2-3.txt.

23. U.S. Department of Energy. Coal Consumption at Electric Utility Plants by Census Division and State for 1995.

24. U.S. Department of Energy (1996). U.S. Coal Consumption at Manufacturing Plants by Standard Industrial Classification (SIC) Code. Table 43. Internet address: http://www.eia.doe.gov/..al/quarterly/T43p01.txt.

25. U.S. Department of Energy. U.S. Coal Consumption by End-Use Sector (1991-1997) Table 37. Internet address: http:\\www.eia.doe.gov/...al/quarterly/t37p01.txt.

26. U.S. Department of Energy (1997a). Manufacturing Consumption of Energy 1994. DOE/EIA-0152(94). December 1997.

27. U.S. Department of Energy (1997b). Petroleum Supply Annual 1996. Volume 1. Energy Information Administration, Office of Oil and Gas, Washington DC, June.

28. U.S. EPA (1995). Toxics Release Inventory (TRI) Database.

29. U.S. EPA (1995a). Profile of the Petroleum Refining Industry. Enforcement and Compliance Assurance Office. EPA 310-R-95-013. September 1995.

30. U.S. EPA (1995b). Preliminary Study of the Iron and Steel Category. Office of Water. EPA-821-R-95-037.

31. U.S. EPA (1997a). Emergency Planning and Community Right-to-Know Act Section 313: Guidance for Electricity Generating Facilities (Version 1). Office of Pollution Prevention and Toxics. October 1997.

32. U.S. EPA (1997b). Economic Analysis of the Final Rule to Add Certain Industrial Groups to EPCRA Section 313. Office of Pollution Prevention and Toxics. April 1997.

33. U.S. EPA (1996). AP-42, Fifth Edition (1996). Section 11. Office of Air Quality Planning and Standards. February.

34. U.S. EPA (1998a). 1996 Toxics Release Inventory.

35. U.S. EPA (1998b). Study of Hazardous Air Pollutant Emissions From Electric Utility Steam Generating Units - Final Report to Congress. Office of Air Quality Planning and Standards. EPA-453/R-98-004 a&b. February.

36. U.S. EPA (1983). Development Document for Effluent Limitation Guidelines and Standards for the Metal Finishing Point Source Category. Office of Water. EPA 440/1-83/091. June.

PERSONAL COMMUNICATIONS

1. Crane, John (Stratcore, 1999). Teleconference between Abt Associates and Mr. John Crane. Recovery of vanadium from spent catalysts from petroleum refineries. September 28.

APPENDIX L
ASSOCIATED REQUIREMENTS

L.1 INTRODUCTION

Some state and federal regulations link fees, pollution prevention planning requirements, and storm water permitting requirements to the requirement to file a Federal Form R; therefore, facilities that become subject to TRI reporting as a result of this rule may incur costs due to those requirements. Sixteen states have pollution prevention fees and/or planning requirements triggered by the filing of a Federal Form R. Facilities that become subject to TRI reporting as a result of this rule, and are located in these states, will incur costs due to those requirements. Also, the EPA National Pollutant Discharge Elimination System (NPDES) general permits for storm water discharges contain special monitoring and pollution prevention requirements for certain facilities subject to EPCRA Section 313. In addition to general permit requirements, EPA has proposed a multi-sector storm water industrial permit covering 29 industrial sectors (58 FR 61147; November 19, 1993). The multi-sector permits contain special pollution prevention requirements for EPCRA Section 313 facilities. Section L.2 discusses state associated requirements and Section L.3 discusses federal (NPDES) associated requirements.

L.2 STATE ASSOCIATED REQUIREMENTS

As of 1997, sixteen states had pollution prevention fees and/or planning requirements triggered by the requirement to file a Federal Form R. Facilities that become subject to TRI reporting as a result of this rule, and are located in these states, will incur costs due to those requirements. This section discusses state required planning requirements, provides state by state summaries of the requirements associated with the filing of Form R, and estimates the fee payments made by industry to satisfy these requirements. Because these costs result from state requirements, they are not attributable to this rule.

L.2.1 STATE POLLUTION PREVENTION PLANNING REQUIREMENTS

Nine states require or encourage TRI reporters to develop a pollution prevention (P2) plan. P2 planning requirements impose a cost on society because they require time and effort on the part of facility staff, consuming resources that could have otherwise been used to generate some alternate output. However, evaluations of the New Jersey Pollution Prevention Planning Program and the Massachusetts Toxics Use Reduction Program indicate that P2 planning produces net benefits for participating facilities as well as society. Preliminary evidence from the New Jersey program shows that for every dollar spent on the P2 planning process, the facilities themselves expect a net savings of $5 to $8 (New Jersey DEP, 1995). This estimate does not include indirect benefits from pollution prevention, such as reduced environmental and worker health impacts and benefits to facilities from increased market share. Similarly, a benefit-cost analysis of the Massachusetts program estimates present value costs for the program of $76.6 million, compared to monetized benefits of $90.5 million (TUR Program, 1997). Monetized

benefits do not include indirect benefits from pollution prevention, such as human health and ecological benefits. The evaluation of the benefits and costs of all state P2 planning requirements is beyond the scope of this report, however, available data indicate that social benefits equal or exceed social costs.

L.2.2 POLLUTION PREVENTION FEES

Unlike P2 planning requirements, fee payments linked to Form R filing do not necessarily equate to social costs. Payments, such as fees and taxes, that do not result in the consumption of resources (e.g., labor) are transfer payments and do not represent costs to society. Payments are transferred from the facility to the public sector, and ultimately to those in society that benefit from the resulting public expenditures. Insufficient information was available to classify the fee payments as either social costs or transfer payments. The requirements and fees established are summarized below by state.

ARIZONA

Arizona requires filers to submit two Form Rs. One form is sent to the state Emergency Response Commission and the other is sent to the Office of Pollution Prevention. The Arizona pollution prevention program currently requires certain non-manufacturing facilities to file Form R, provided they meet the following criteria: During the preceding calendar year, the facility generated an average of one kilogram per month of acutely hazardous waste as defined in 40 code of federal regulations part 261 or an average of one thousand kilograms per month of hazardous waste in a calendar year, exclusive of an episodic, accidental or remediation related release or occurrence. Facilities meeting this threshold must file Form R regardless of SIC code or number of employees. Thus, facilities reporting under the final rule may already be reporting. In addition, Arizona mandates the development of a pollution prevention plan and progress report for all facilities submitting Form R (A.R.S. Title 49 sections 961-973). The state does not outline specific pollution prevention goals.

COLORADO

Colorado requires Form R filers to pay a fee to the Pollution Prevention Program. The fee is $25 per chemical reported under Section 313. The fee supports a pollution prevention fund which provides technical assistance and education grants for pollution prevention activities. The development of a pollution prevention plan is voluntary.

FLORIDA

Florida requires facilities that submit Form R to pay a fee of $150 per form. Except for the $150 fee, the Florida TRI reporting requirements mirror Federal reporting requirements. The Florida program also encourages but does not require the development of a pollution prevention plan.

IOWA

Previously, Iowa required facilities that submit Form R to pay an air toxics fee based upon their most recently reported emissions. However, this fee is no longer assessed. Iowa encourages voluntary development of pollution prevention plans but does not mandate them. No other state requirements or fees are linked to the filing of Form R.

KANSAS

Kansas requires facilities that submit Form R to pay a fee based on the quantity of toxic chemicals released or transferred (K.S.A. § 2856-4). The fee structure is as follows: $250 for facilities releasing between 100 and 19,999 lbs, $700 for facilities releasing between 20,000 and 99,999 lbs., $1,700 for facilities releasing between 100,000 and 999,999 lbs., and $3,000 for facilities releasing in excess of 1 million lbs. Total payments are not to exceed $3,000. Previously, Kansas allowed Section 313 filers to bank their fees as credit toward a Clean Air Act fee, however, this is no longer allowed due to a lack of participation.

MAINE

Maine requires that facilities submitting Form R pay fees to both the Emergency Response Commission as well as the Toxics Reduction Program. Two fees are assessed to fund the Emergency Response Commission. One is a flat rate of $50 per facility which supports the pollution prevention office. The amount of the second fee is dependent on the quantity of TRI chemicals released. The fee schedule is as follows: $20 for each form reporting 1-499 lbs., $50 for each form reporting 500-999 lbs., $70 for each form reporting 1,000-9,999, $100 for each form reporting 10,000-99,999 lbs., $150 for each form reporting 100,000-999,999, and $200 for each form reporting a million or more lbs. Revenue from this fee is placed in the Emergency Response Fund.

Facilities filing Form R must also pay a fee of $100 per chemical to fund the activities of the Toxics Reduction Program. Facilities subject to section 312 of EPCRA and RCRA hazardous waste generators must also pay fees to the Toxics Reduction Program, independent of Form R fees. Total fees (i.e., Section 313, Section 312, and Hazardous Waste Generator fees) collected by the Toxics Reduction Program are not to exceed $1,000 per company (not facility). Payments are projected to increase between $37,576 and $108,698. The minimum payment is calculated based on the assumption that 48 non-manufacturing facilities incur the $50 flat fee and a combined per chemical fee of $120. The maximum fee is calculated based on the assumption that 48 non-manufacturing facilities incur the $50 flat fee, a cost of $200 per chemical, and a cost of $1,000 per company (i.e., none of the facilities are subject to Section 312 fees or Hazardous Waste Generator fees).

MASSACHUSETTS

The Massachusetts Toxics Use Reduction Act (TURA) requires that certain non-manufacturing facilities file Form R. Filers are assessed an annual fee based upon the number of

employees at the facility as well as the number of chemicals reported. In addition, Massachusetts requires that these facilities prepare a toxic use reduction plan.

Facilities subject to TURA are assessed a two-tiered, annual fee based on the number of employees at their facility as well as the number of chemicals reported. The base fee establishes a minimum payment which varies according to the number of full-time employees working at a facility. In addition to the base fee, filers are assessed a fee of $1,100 per chemical reported. Maximum fees are set according to the number of full-time employees and range from $5,550 to $31,450 per facility. The fee schedule is summarized in the table below.

Facility Size	**Toxics Use Fee Schedule**
10-49 full-time employees	$1,850 plus $1,100 per chemical, not to exceed a total combined fee of $5,550.
50-99 full-time employees	$2,775 plus $1,100 per chemical, not to exceed a total combined fee of $7,400.
100-499 full-time employees	$4,625 plus $1,100 per chemical, not to exceed a total combined fee of $14,800.
500+ full time employees	$9,250 plus $1,100 per chemical, not to exceed a total combined fee of $31,450.

MINNESOTA

The Minnesota Toxic Pollution Prevention Act requires the payment of a pollution prevention fee based upon toxic chemical releases reported on Form R. Revenues from the fee support Minnesota's pollution prevention assistance activities, including: the Minnesota Technical Assistance Program, grants, workshops, and conferences. Minnesota requires certain non-manufacturing facilities to report releases of listed chemicals on Form R. Facilities reporting less than 25,000 pounds annually of toxic chemicals released are assessed a fee of $500. Facilities reporting annual releases of toxic chemicals in excess of 25,000 pounds are assessed a graduated fee of $0.02 per pound of toxic chemicals released. There is no maximum fee.

In addition, facilities that report releases and/or transfers under EPCRA Section 313 are required by the Hazardous Materials Incident Response Act to pay an annual fee based upon the quantity of toxic chemicals released or transferred. The act establishes a fee structure to support the state's regional response teams and chemical assessment teams that respond to hazardous materials emergencies. The fee schedule is as follows: $200 for Form R filers reporting 0 lbs. released or transferred, $400 for Form R filers reporting 1 to 25,000 lbs. released or transferred, and $800 for Form R filers reporting more than 25,000 lbs. released or transferred. Total pounds released or transferred are summed across all chemicals reported.

MISSISSIPPI

Mississippi requires facilities that submit Form R to develop a waste minimization plan and pay a fee based upon the amount of material released. Mississippi Code §49-31 addresses state requirements for facilities required to file Form R under section 313. More specifically, Mississippi Code §49-31-25 levies a tax based on the amount of hazardous material released. The

waste minimization tax is imposed upon each large quantity generator and each small quantity generator regulated under the Mississippi hazardous waste management regulations as well as Form R filers. Facilities that are subject to both hazardous waste management regulations and Section 313, must calculate their fee based upon total RCRA hazardous waste quantities and fugitive and stack air toxic chemical releases reported on Form R. Effective July 1, 1995, facilities may exclude any hazardous waste recycled on-site or shipped off-site for recycling as reported on the Mississippi Annual Hazardous Waste Report or reported under EPCRA Section 313 from their calculation of the pollution prevention fee. In addition, any hazardous waste or chemical for which a Title V permit fee is assessed can also be excluded from the calculation of the pollution prevention fee. The fee schedule is as follows:

Tons Generated/Released	Annual Tax ($)
0.01 - 9.99	250
10.00 - 99.99	500
100.00 - 999.99	1,500
1,000.00 - 9,999.99	2,500
10,000.00 - 49,999.99	10,000
50,000.00 +	50,000

In addition to the fee payments required by §49-31-25, Mississippi Code §49-31-21 mandates the development of a hazardous waste minimization plan by every facility that files Form R. Small quantity generators are required to prepare a four page waste minimization form. Large quantity generators and Form R filers must prepare a full waste minimization plan.

NEVADA

Nevada Public Law 49-999 requires facilities that submit Form R to pay a fee of $500 per form. Total fees incurred under section 311, 312, and 313 are capped at $5,000 per facility. The fee supports operations of the Local Emergency Planning Committees, training of haz-mat first responders, and equipage for haz-mat responses.

NEW JERSEY

The New Jersey Worker and Community Right to Know Act (N.J.S.A. 34:5-1 et seq.) requires that TRI reporters file a state Release and Pollution Prevention Report. Facilities are to provide general facility information and chemical specific information about production, throughput, inventory, and releases, waste management and pollution prevention. In addition, the New Jersey Pollution Prevention Act (statutes 13:1D) requires facilities covered by Section 313 reporting requirements to develop a pollution prevention plan and conduct pollution prevention reporting. The Act requires facilities to report on pollution prevention activities, submit a pollution prevention plan, and provide annual pollution prevention updates. The state does not

specify pollution prevention goals for the facilities; it only mandates that a pollution prevention plan be developed and that pollution prevention reporting occur.

OHIO

Ohio requires facilities that submit Form R to pay an annual combined fee of $50 per facility plus $15 per chemical reported. Ohio Code §3751 requires that Ohio reporting requirements be equivalent to Section 313 in scope, content, and coverage.

OREGON

Oregon's Toxics Use Reduction and Hazardous Waste Reduction Act of 1989 requires that facilities required to file Form R engage in hazardous waste reduction planning by mandating the preparation of pollution prevention plans and annual progress reports. Plans must include a written policy statement showing upper management support for the program, numeric reduction goals for certain toxic substances and hazardous waste streams, an analysis of toxics use and hazardous waste generation, identification of reduction opportunities and implementation strategies, establishment of employee awareness and training programs, and institutionalization of the program to ensure an on-going effort. Two classes of toxics users are subject to the Act, in addition to current Form R filers: large quantity hazardous waste generators and small quantity hazardous waste generators.

PENNSYLVANIA

Pennsylvania Act 165 requires each facility filing Form R to pay a fee of $250 per chemical. Total payments per facility are not to exceed $5,000.

SOUTH DAKOTA

The South Dakota Department of Environment and Natural Resources (DENR) requires that facilities submitting Form R pay a fee based upon the release quantity for each chemical reported. Fees per chemical are assessed according to the following schedule and maximum payments by any single facility are capped at $3,000:

Pounds Emitted	Fee ($)
0 - 9,999	250
10,000 - 19,999	350
20,000 - 29,999	450
30,000 - 39,999	550
40,000 - 49,999	650
50,000 - 74,999	800
75,000 - 99,999	1,000
100,000 - 249,999	1,300
250,000 - 499,999	1,600
500,000 - 749,999	2,000
750,000 - 999,999	2,500
1,000,000 +	3,000

TEXAS

Texas requires facilities submitting Form R to pay a $25 fee for each form submitted. Total fees are capped at $250 per facility. The Waste Reduction Act of 1991 requires facilities that "generate hazardous waste" or file Form R to prepare a pollution prevention plan.

L.3 NPDES STORM WATER PERMITS

Under the National Pollutant Discharge Elimination System (NPDES) permitting program for storm water, NPDES permits are required for all point source discharges of storm water associated with industrial activity. EPA developed two permit application options for industrial sources: individual permit applications and group applications. EPA may issue either an individual permit or a general permit, which might require submission of a notice of intent to be covered under such general permit. EPA storm water general permits apply in 11 states that are not authorized to administer the NPDES program, as well as certain territories, federal lands and Indian lands where EPA is the permitting authority. However, the permits may be used as a model by the other states that are authorized to administer the NPDES program.

EPA issued National Pollutant Discharge Elimination System (NPDES) general permits for storm water discharges associated with industrial activity on September 9, 1992 (57 FR 41236). The "baseline" general permits require that subject facilities prepare and implement storm water pollution prevention plans in order to reduce the pollutants in storm water discharges. In

addition to the baseline requirements, there are special monitoring and pollution prevention requirements for certain facilities subject to EPCRA section 313.

Not all facilities subject to EPCRA Section 313 are subject to these NPDES requirements. A facility that submits Form R is subject to storm water permitting requirements only if industrial materials or activities are exposed to storm water, and if the facility is reporting to TRI for one of the "section 313 water priority chemicals" as defined under the NPDES requirements. Section 313 water priority chemicals are those chemicals listed under EPCRA section 313 that are also: (1) listed in Appendix D of 40 CFR Part 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides and phenols), or Table V (certain toxic pollutants and hazardous substances); (2) are listed as hazardous substances pursuant to section 311(b)(2)(A) of the Clean Water Act at 40 CFR 116.4; or (3) are pollutants for which EPA has published acute or chronic toxicity criteria. Approximately 200 of the EPCRA Section 313 chemicals are classified as "section 313 water priority chemicals" for the purpose of the storm water discharge general permits.

EPA subsequently proposed a multi-sector storm water industrial permit covering 29 industrial sectors (58 FR 61147; November 19, 1993). The draft multi-sector permit covers a variety of different industrial categories such as primary metals, chemicals and allied products, automobile salvage yards, and textile mills. In addition to requirements which pertain to all facilities, each industry sector in the multi-sector permit has certain industry-specific requirements. The multi-sector permits also have special pollution prevention requirements for EPCRA section 313 facilities.

Both the "baseline" general and multi-sector general permits require EPCRA Section 313 facilities to develop pollution prevention plans in order to claim coverage under the permit. These plans must contain special provisions (known as Best Management Practices, or BMPs) addressing areas where Section 313 water priority chemicals are stored, processed, or otherwise handled. Pollution prevention plan requirements reflect the Best Available Technology for controlling discharges of water priority chemicals in storm water. The permits require that such pollution prevention plans specify that appropriate containment, drainage control and/or diversionary structures be provided for such areas. The proposed general permits further specified that the pollution prevention plans be reviewed and certified by a Registered Professional Engineer (PE) every three years.

In addition to the BMPs, Section 313 facilities subject to the "baseline" general permits must also conduct semi-annual monitoring for the Section 313 water priority chemicals in their storm water discharges that come into contact with any equipment, tank, container, or other vessel or area used for storage of a Section 313 water priority chemical. There are no special monitoring requirements specific to Section 313 facilities under the multi-sector permits (although facilities in particular industrial sectors may be required to monitor for certain chemicals of concern that are also listed under Section 313).

EPA expects the majority of facilities to have existing containment systems that meet the majority of the BMP requirements of these permits. For these facilities, the only costs will be preparation of the plan (at a cost of approximately $630), and PE certification (at an annualized cost of $53 to $1,000 per year). Facilities that lack such systems would have to undertake some actions to upgrade existing containment systems to meet the requirements of the permit. The initial costs for these facilities to minimize the discharge of Section 313 water priority pollutants vary depending on the system being upgraded, and could range from $560 (for material storage areas) to $21,000 (for loading areas). The annual costs for facilities that currently lack necessary systems could range from $1,403 per year (for employee training) to $5,957 (for housekeeping and maintenance activities). Industrial storm water monitoring requirements are estimated to cost from $2,424 to $4,847 per year. The total cost of compliance would depend on the size of the facility, the chemicals being stored or used, the nature of the plant operations, the processes used at the plant, and the housekeeping measures employed.

These special requirements are based on the coverage of EPCRA Section 313 at the time the permits were issued. The requirements do not apply to facilities that must report to TRI because chemicals are subsequently added to the EPCRA Section 313 list of toxic chemicals, or because EPCRA Section 313 reporting requirements are subsequently expanded to facilities outside SIC 20-39. The NPDES requirements do not apply until the time of permit renewal (which occurs every 5 years), and then only if EPA reissues the "baseline" general permit in its current form.

LITERATURE CITED

1. New Jersey Department of Environmental Protection (1995). *Early Findings of the Pollution Prevention Program, Part I: On-Site Reviews of Pollution Prevention Plan*. June.

2. TUR Program, Massachusetts Toxics Use Reduction Program (1997). *Evaluating Progress: A Report on the Findings of the Massachusetts Toxics Use Reduction Program*. March.